Tektronix®
COMMITTED TO EXCELLENCE

1420 NTSC
1421 PAL
1422 PAL-M
VECTORSCOPE
(SN B050000 AND UP)

INSTRUCTION MANUAL

Tektronix, Inc.
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WARRANTY

Tektronix warrants that this product is free from defects in materials and workmanship. The warranty period is one (1) year from the date of shipment. Tektronix will, at its option, repair or replace the product if Tektronix determines it is defective within the warranty period and if it is returned, freight prepaid, to a service center designated by Tektronix.

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PREFACE

This Preface describes the contents of the manual, with a brief description of each section within the manual. The Operators and Servicing Safety Summaries are also included here.

The Table of Contents is a detailed list of all important pieces of information and their location in the manual.

The manual is split into two parts, Operator's Information and Service Information. All pertinent information regarding the operation of the instrument is located in the Operator's part. This will be of use to both the operator and the service technician. The Service part contains information necessary to effectively service the instrument. This information should be used only by qualified service technicians.

The Operators part includes Sections 1 and 2:

Section 1, Introduction and Specification, includes a general description of the instrument, and the specification.

Section 2, Operating Instructions, includes information on controls, connectors, and operator familiarization.

The Service part contains Sections 3 through 10:

Section 3, Installation, covers the operating power information required for the instrument. Also the mechanical installation of the instrument is discussed.

Section 4, Theory of Operation, begins with a general overview of the instrument, followed by a detailed circuit description.

Section 5, Calibration, includes a Performance Check, Adjustment Procedure, and an equipment list.

Section 6, Maintenance, covers the standard electrical and mechanical maintenance, plus any special tools, unusual components, and special handling.

Section 7, Options, documents any options available with the instrument.

Section 8, Replaceable Electrical Parts list, includes ordering information and part numbers for all replaceable electrical parts.

Section 9, Diagrams, includes a Block Diagram, Schematics, Circuit Board illustrations, component basing diagrams, waveforms, and adjustment location illustrations.

Section 10, Replaceable Mechanical Parts list, refers to an exploded-view drawing of the instrument, and lists ordering information for all replaceable mechanical parts.

Change and correction information after the manual has been printed is located behind a tabbed page at the rear of the manual.

The text and diagrams are in accord with, and based on, the following standards of the American National Standards Institute, Inc. (ANSI):

ANSI Y1.1—1972, Abbreviations

ANSI Y32.2—1975, Graphic Symbols

ANSI Y32.14—1973, Graphic Symbols (Logic)

ANSI Y32.16—1975, Reference Designators

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PART 1—OPERATOR'S INFORMATION

WARNING

THE FOLLOWING SERVICING INSTRUCTIONS ARE FOR USE BY QUALIFIED SERVICE PERSONNEL ONLY. TO AVOID PERSONAL INJURY, DO NOT PERFORM ANY SERVICING OTHER THAN THAT CONTAINED IN OPERATING INSTRUCTIONS UNLESS YOU ARE QUALIFIED TO DO SO.

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LIST OF TABLES

OPERATORS SAFETY SUMMARY

The general safety information in this part of the summary is for both operating and servicing personnel. Specific warnings and cautions will be found throughout the manual where they apply, but may not appear in this summary.

TERMS

In This Manual

CAUTION statements identify conditions or practices that could result in damage to the equipment or other property.

WARNING statements identify conditions or practices that could result in personal injury or loss of life.

As Marked on Equipment

CAUTION indicates a personal injury hazard not immediately accessible as one reads the marking, or a hazard to property including the equipment itself.

DANGER indicates a personal injury hazard immediately accessible as one reads the marking.

SYMBOLS

As Marked on Equipment


DANGER — High voltage.


Protective ground (earth) terminal.

Power Source

This product is intended to operate from a power source that will not apply more than 250 volts rms between the supply conductors or between either supply conductor and ground. A protective ground connection by way of the grounding conductor in the power cord is essential for safe operation.

Grounding the Product

This product is grounded through the grounding conductor of the power cord. To avoid electrical shock, plug the power cord into a properly wired receptacle before connecting to the product input or output terminals. A protective ground connection by way of the grounding conductor in the power cord is essential for safe operation.

Danger Arising From Loss of Ground

Upon loss of the protective-ground connection, all accessible conductive parts (including knobs and controls that may appear to be insulating) can render an electric shock.

Use the Proper Power Cord

Use only the power cord and connector specified for your product.

Use only a power cord that is in good condition.

For detailed information on power cords and connectors, see Table 3-1 in the Installation section.

Refer cord and connector changes to qualified service personnel.

Use the Proper Fuse

To avoid fire hazard, use only the fuse of correct type, voltage rating and current rating as specified in the parts list for your product.

Refer fuse replacement to qualified service personnel.

Do Not Operate in Explosive Atmospheres

To avoid explosion, do not operate this product in an explosive atmosphere unless it has been specifically certified for such operation.

Do Not Remove Covers or Panels

To avoid personal injury, do not remove the product covers or panels. Do not operate the product without the covers and panels properly installed.

SERVICING SAFETY SUMMARY

FOR QUALIFIED SERVICE PERSONNEL ONLY

Refer also to the preceding Operators Safety Summary.

Do Not Service Alone

Do not perform internal service or adjustment of this product unless another person capable of rendering first aid and resuscitation is present.

Use Care When Servicing With Power On

Dangerous voltages exist at several points in this product. To avoid personal injury, do not touch exposed connections and components while power is on.

Disconnect power before removing protective panels, soldering, or replacing components.

Power Source

This product is intended to operate from a power source that will not apply more than 250 volts rms between the supply conductors or between either supply conductor and ground. A protective ground connection by way of the grounding conductor in the power cord is essential for safe operation.

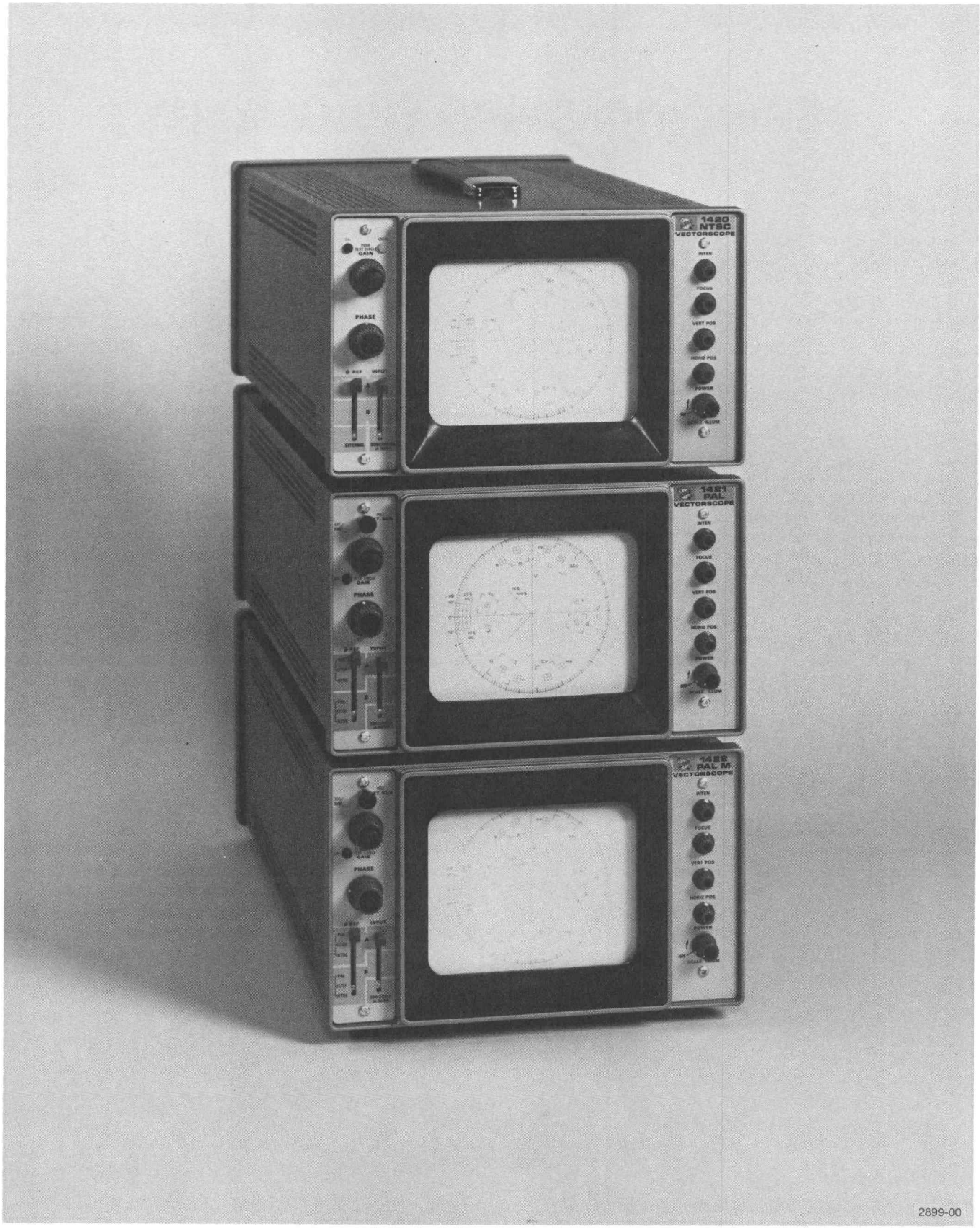

Fig. 1-1. The 1420 NTSC, 1421 PAL, and 1422 PAL-M Vectorscopes.

PART 1

OPERATOR'S INFORMATION

INTRODUCTION AND SPECIFICATION

INTRODUCTION

The TEKTRONIX 1420 NTSC, 1421 PAL, and 1422 PAL-M Vectorscopes are compact (one-half rack width, 5-1/4 inches vertical height) television instruments designed to display and measure chrominance information from a composite color video signal. The chrominance information, saturation, and hue are displayed on the crt in a polar plot fashion. The radius of the polar plot is a function of saturation, the peak-to-peak amplitude of the chrominance signal; the angular (phase) displacement is relative to the hue information, phase difference between the chrominance information and the reference vector (burst).

A front-panel lever switch (INPUT) allows selection of display from either of the two channel inputs, A or B. The lever switch also allows the selection of Channel A INPUT with attenuation to allow viewing of large signals.

The 1420 is designed to be used with NTSC, 525/60 scan television systems. The 1421 is designed to be used with PAL, 625/50 scan television systems. The 1422 is designed to be used with PAL-M, 525/60 scan television systems. The vector display may be referenced to either an internal or external subcarrier source.

The graticule markings provide references for butst and the primary and complementary color vectors and allow measurement of differential phase and differential gain.

The graticule illumination lights allow taking waveform display photographs in which the graticule is clearly visible.

SPECIFICATION

The performance requirements listed here apply over an ambient temperature range of 0° C to +50° C. The rated accuracies are valid when the instrument is calibrated at +20° C to +30° C with warm-up time of ten minutes. A twenty minute warm-up is required for rated accuracies at 0° ambient temperature.

Items listed in the Performance Requirements column of Table 1-1 are verified by completing the Performance Check in this manual unless specifically stated otherwise. Items listed in the Supplemental Information column may not be verified in this manual; they are either explanatory notes or performance characteristics for which no limits are specified.

Table 1-1

ELECTRICAL CHARACTERISTICS

Characteristics	Performance Requirements	Supplemental Information	Perf. Ch. Step No.
Chrominance Processing Characteristics			
Chrominance Bandwidth			
Subcarrier Frequency (F_{sc})			

Table 1-1 (cont)

Characteristics	Performance Requirements	Supplemental Information	Perf. Ch. Step No.
Chrominance Processing Characteristics (cont)			
Chrominance Bandwidth (cont)			
Subcarrier Frequency (F_{SC}) (cont)			
1420 NTSC		3.579545 MHz	
1421 PAL		4.43361875 MHz	
1422 PAL-M		3.575611 MHz	
Upper −3 dB point	F_{sc} +500 kHz ±100 kHz		23
Lower −3 dB point	F_{sc} −500 kHz ±100 kHz		23
Vector Phase Accuracy	Within 1°		5
Quadrature Phasing	Within 0.25°		18
Subcarrier Regenerator			
1420		Phase-locked to in-coming subcarrier or burst when present at A INPUT or B INPUT with ϕ REF set to either Channel A or B. Otherwise, free-running. Disabled when ϕ REF is set to EXT.	
1421 and 1422		With EXT SUB set to INT, the Subcarrier Regenerator is phase-locked to the incoming subcarrier or burst when present at A INPUT or B INPUT with ϕ REF set to either Channel A or B. Otherwise, free-running. Subcarrier Regenerator is disabled when EXT SUB is set to EXT.	
Pull-In Range	Within 50 Hz of F_{sc}		No Performance Check provided[a]
Pull-In Time	Within 1 second with subcarrier frequency within 50 Hz of F_{sc}		
Phase Shift with Subcarrier Frequency Change	Within 0.5° from F_{sc} to F_{sc} +50 Hz, or F_{sc} to F_{sc} −50 Hz		
Phase Shift with Burst Amplitude Change	Within 2° from nominal burst amplitude to +6 dB, or from nominal burst amplitude to −6 dB		21
Phase Shift with Subcarrier Source Change	Within 0.5°	ϕ REF switched between A and B	11d
Phase Shift with Input Channel Change	Within 0.5°	Video INPUT switched	11b

Table 1-1 (cont)

Characteristics	Performance Requirements	Supplemental Information	Perf. Ch. Step No.
Chrominance Processing Characteristics (cont)			
Phase Shift with Front Panel GAIN Control	Within 1°	From unity to 2X unity, or from unity to 0.5X unity	11f
Phase Control Range		360° continuous rotation with goniometer	
Burst Jitter	0.5° or less		15
EXT SUB REF Input			
Amplitude Range	1 V to 4 V p-p		17
Input DC Voltage		±20 V (max.)	
Frequency (F_{sc})			
1420		3.579545 MHz ±50 Hz	
1421		4.4361875 MHz ±50 Hz	
1422		3.575611 MHz ±50 Hz	
EXT PAL PULSE Input (1421 and 1422 only)			
Amplitude Range	1 V to 5 V p-p		16
Input DC Voltage		±20 V (max.)	
Polarity		Negative going	
Pulse Timing		4 μs to H/2	
Phasing		Negative transition coincident with leading edge of line sync on either +V or −V lines. Internally selectable. Factory set to +V.	
Amplifier Characteristics			
INPUT Amplitude Range		1 V ±6 dB	
INPUT DC Voltage (max)		+20 V, −20 V	
Front Panel GAIN	Unity to +15.12 dB, Unity to −6 dB	Unity to 5.7X unity, and unity to 0.5X unity	12
Gain Stability			
With Temperature Change	0.5% or less from 0° C to 50° C		No Performance Check provided[b]
With Mains Voltage Change	2% or less as main voltage changes ±10% from center of range	Range selectable by internal plug-jumpers	No Performance Check provided[c]

Table 1-1 (cont)

Characteristics	Performance Requirements	Supplemental Information	Perf. Ch. Step No.
Amplifier Characteristics (cont)			
Position Control Range			
HORIZ	At least 1/4" from center		19d
VERT	At least 1/4" from center		19b
Clamp Stability			
Center spot movement with rotation of PHASE control	1/64" or less		20
INPUT Isolation	At least −80 dB between channels	At F_{sc}	24
Return Loss			
A INPUT and B INPUT	At least 46 dB down	Loop-through terminated in 75 Ω. Input in use or not in use, instrument on or off. 50 Hz to 5 MHz	25e
EXT SUBCARRIER REFERENCE Input	At least 34 dB down		25h
EXT PAL PULSE	At least 34 dB down		25i
Diff Phase	1° or less		14
Diff Gain	1% or less		13
Power Supply Characteristics			
Power Supplies			
Accuracy			
+15 V		±2% (±0.3 V); +14.7 V to +15.3 V	
−15 V		±1% (±0.15 V); −14.85 V to −15.15 V	
+210 V		±10% (±21.0 V); 189.0 V to +231.0 V	
−3500 V		Approximate	
Ripple			
+15 V		10 mV or less	
−15 V		10 mV or less	
+210 V		1 V or less	
Mains Voltage Range		Mains Voltage and Range are selectable by internal plug-jumpers	
110 Vac			
Low	90 Vac to 110 Vac (100 Vac Nominal)		
Med	99 Vac to 121 Vac (110 Vac Nominal)		

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Table 1-1 (cont)

Characteristics	Performance Requirements	Supplemental Information	Perf. Ch. Step No.
Power Supply Characteristics (cont)			
Mains Voltage Range (cont)			
High	108 Vac to 132 Vac (120 Vac Nominal)		
220 Vac			
Low	180 Vac to 220 Vac (200 Vac Nominal)		
Med	198 Vac to 242 Vac (220 Vac Nominal)		
High	216 Vac to 264 Vac (240 Vac Nominal)		
Crest Factor		At least 1.35	

[a]**Performance Check may be made using a video signal generator with a variable subcarrier oscillator of + and −50 Hz from F_{SC}.**

[b]**Performance Check may be made using an environmental chamber that the instrument would fit into.**

[c]**Performance Check may be made using a variable mains voltage source.**

Table 1-2

ENVIRONMENTAL CHARACTERISTICS

Characteristics	Information
Temperature	
Non-operating	−40° C to +65° C
Operating	0° C to +50° C
Altitude	
Non-operating	To 50,000′
Operating	To 15,000′

Table 1-3

PHYSICAL CHARACTERISTICS

Characteristics	Information
Length	18.5″ (46.99 cm)
Width	8.5″ (21.59 cm)
Weight	5.25″ (13.34 cm)
Weight	Less cabinet, 13 lb (6.0 kg)

OPERATING INSTRUCTIONS

INTRODUCTION

This section of the manual will help familiarize the user with the 1420 NTSC, 1421 PAL, and 1422 PAL-M Vectorscopes. Common features and functions are covered, while pertinent model differences are described at appropriate intervals. The term "Vectorscope" in the manual text indicates your particular instrument model. Included in this section are:

1. An explanation of the functions of the controls, connectors, and indicators.

2. A check-out procedure that provides "hands-on" familiarization.

3. An operator familiarization section that provides basic color television principles as it relates to the vectorscope.

4. An explanation of how to use the vectorscope graticule.

CONTROLS, CONNECTORS, and INDICATORS

Introduction

The following describes the functions or operations of the various controls and connectors found on the front- and rear-panel of the 1420, 1421, and 1422 Vectorscope. The front- and rear-panel controls, connectors, and indicators are shown in Fig. 2-1 and Fig. 2-2.

Front Panel (Left Side)

PUSH—TEST CIRCLE. By pressing the center portion of the knob marked GAIN, the subcarrier regenerator is unlocked from the reference and the 180° phase switcher is operating. This feature is useful in checking horizontal and vertical gain match and quadrature phasing.

GAIN. The outer part of the knob rotates to provide a variable gain control to vary the amplitude of the input composite video signal. The control has a calibrated detent position in the extreme ccw position.

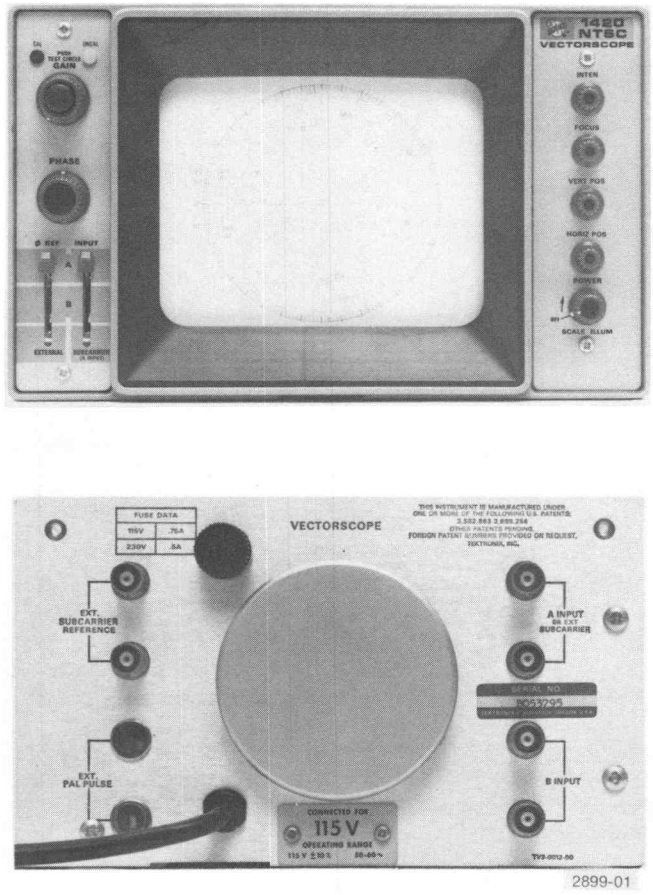

Fig. 2-1. 1420 Front and Rear Panels.

CAL (Indicator). Incandescent lamp indicates that the GAIN control is in the calibrated detent position.

UNCAL (Indicator on 1420 only). Incandescent lamp indicates that the GAIN control is not in the calibrated detent position.

PHASE. Provides a continuously uncalibrated control of the display's phase position through a range of 360°.

INPUT. Three-position lever switch that allows the user to select signal information to be displayed from the rear panel A INPUT or B INPUT connectors. The SUB-

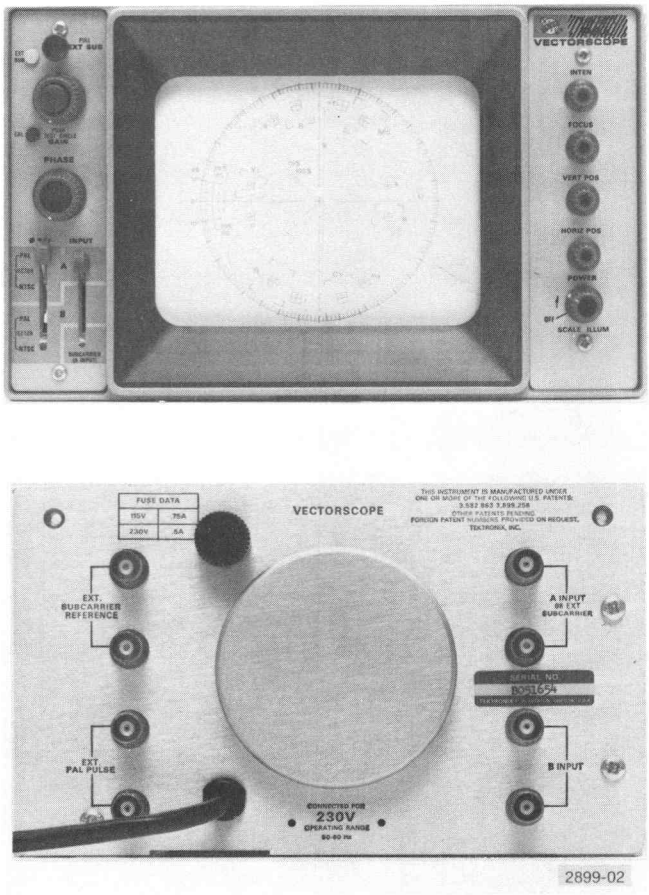

Fig. 2-2. 1421, 1422 Front and Rear Panels.

CARRIER (A INPUT) position displays the signal from the A INPUT connector with an attenuation loss of about 2 1/4 times or 6.9 dB.

ϕ REF (1420). Three-position lever switch used to select the subcarrier reference phase for the Vectorscope display. In the first two positions, A or B, the subcarrier reference phase is derived from the internal subcarrier regenerator, which is phase-locked to the subcarrier reference at the input connector selected. In the third position, EXTERNAL, the subcarrier reference phase is obtained from a continuous 3.58 MHz subcarrier reference signal applied to the EXT SUBCARRIER REFERENCE INPUT.

ϕ REF (1421, 1422). Four-position lever switch that selects two functions of operations. The first operation to consider is the subcarrier reference source to phase-lock the internal subcarrier regenerator. The subcarrier regenerator provides the subcarrier reference phase for the Vectorscope's display. The subcarrier reference used to phase-lock the subcarrier regenerator is either obtained from the A INPUT or B INPUT as indicated on the right side of the switch.

The other function this switch provides is either a PAL VECTOR or NTSC VECTOR display. The PAL VECTOR position displays a normal PAL signal with alternating burst and chrominance phase (see Fig. 2-3). The NTSC VECTOR position enables the 180° phase switcher. This allows the overlaying of the −V phase on the +V phase display (see Fig. 2-4).

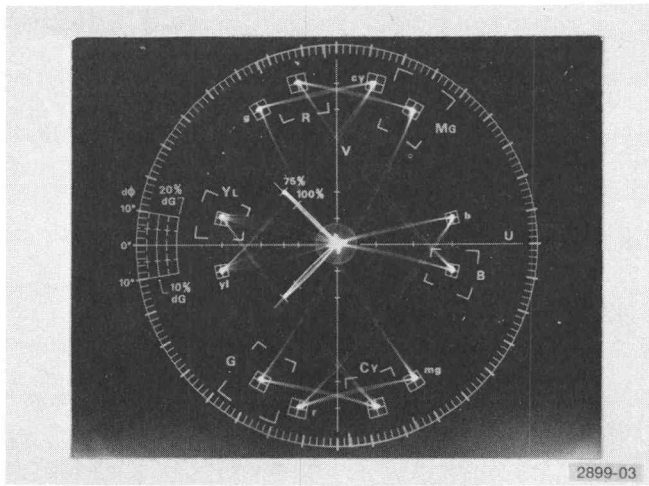

Fig. 2-3. 1421, 1422 PAL color bar vector display.

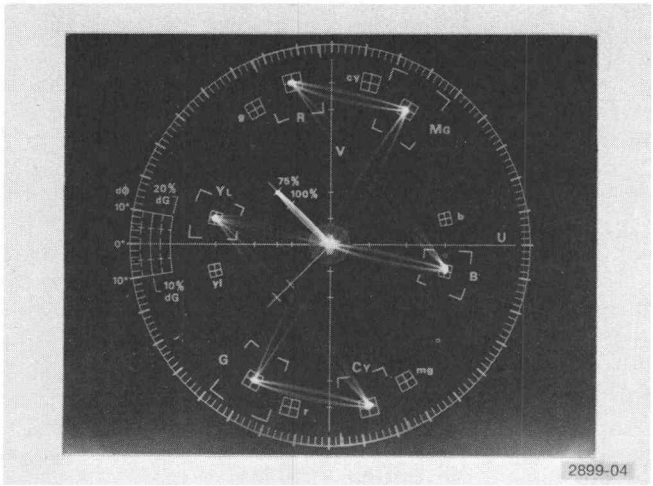

Fig. 2-4. 1421, 1422 PAL color bar NTSC vector display.

EXT SUB (1421, 1422). Push/pull switch to allow the subcarrier reference phase to be selected from either the internal subcarrier regenerator or a continuous subcarrier signal applied to the EXT SUBCARRIER REFERENCE input and a PAL Pulse signal applied to the EXT PAL PULSE input. The external reference circuitry is activated by pulling the knob out. The ϕ REF switch still allows the

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user to select either PAL or NTSC VECTOR display while still referenced to the external subcarrier and external PAL Pulse.

EXT SUB (Indicator for 1421, 1422). Incandescent lamp that indicates if the Vectorscope is in the External Subcarrier Reference mode of operation.

Front Panel (Right Side)

INTEN. Controls the display brightness.

FOCUS. Controls the display resolution.

VERT POS. Moves the display on the R-Y (V) axis.

HORIZ POS. Moves the display on the B-Y (U) axis.

POWER. Turning the knob clockwise out of the detent position turns the instrument on.

SCALE ILLUM. Turning the knob clockwise increases the scale illumination.

Rear Panel

A INPUT. Dual-input bnc connectors permit loop-through or terminates in 75 Ω. Accepts composite video or subcarrier signals to be displayed on Channel B and/or for locking the subcarrier regenerator.

B INPUT. Dual-input bnc connectors permit loop-through or terminate in 75 Ω. Accepts external, continuous subcarrier to be used as an external subcarrier reference phase.

EXT SUBCARRIER REFERENCE. Dual-input bnc connectors permit loop-through or terminates in 75 Ω. Accepts external, continuous subcarrier to be used as an external subcarrier reference phase.

EXT PAL PULSE (1421, 1422). Dual-input bnc connectors permit loop-through or terminates in 75 Ω. Accepts external PAL Pulse to be used with the encoder in the Vectorscope to maintain correct phase of the V axis signals. The phasing requirements of the PAL Pulse for the Vectorscope may be reversed by internal selection.

FUSE. Fuse holder that contains the mains input voltage fuse.

OPERATOR'S CHECKOUT PROCEDURE

The Checkout Procedure is divided into two sections, one for checking the 1420 Vectorscope and the other for checking the 1421 and 1422 Vectorscopes. The procedures are provided to aid in obtaining a display on the Vectorscope, and may be used for operator familiarization and as a check of basic instrument operation. Only instrument functions, not measurement quantities or specifications, are checked in this procedure. Therefore, a minimum amount of test equipment is required. If performing the Operator's Checkout Procedure reveals improper operation or instrument malfunction, first check the operation of associated equipment, then refer to qualified service personnel for repair or adjustment of the instrument.

1420 CHECKOUT PROCEDURE

This procedure requires a video signal generator capable of providing composite video and color bars signals. A TEKTRONIX 1410 video test generator equipped with Sync Generator, Color Bar, and Linearity modules was used in preparing this procedure.

1. Setup

Video Signal Generator

Test Signal	Standard NTSC Color Bar
Amplitude	75%
Setup	7.5%

1420

GAIN	CAL
PHASE	Anywhere
ϕ REF	B
INPUT	B
INTEN	ccw
FOCUS	midrange
VERT POS	midrange
HORIZ POS	midrange
POWER	off

a. Connect composite video from the video signal generator to the 1420 B INPUT. Terminate the B INPUT loop-through in 75 Ω.

b. Connect subcarrier from the video signal generator to the 1420 A INPUT. Terminate the A INPUT loop-through in 75 Ω.

NOTE

Check the line voltage information indicated on the rear panel. If the power source voltage is not within

the factory-set range, have a qualified service person change the voltage operating range of the 1420. The necessary information is in the Service Information of this instruction manual.

c. Connect the 1420 to a suitable power source.

d. Set the 1420 POWER switch ON. Check that the front-panel CAL lamp is lit. Check that the SCALE ILLUM control (concentric with POWER switch) varies brightness of the graticule. Allow 10 minutes warm-up before proceeding.

2. Vector Presentation of Color Bars

a. Rotate the 1420 INTEN and FOCUS controls for a bright, well-defined display.

b. Rotate the 1420 VERT POS and HORIZ POS controls to center the display origin at graticule center.

c. Rotate PHASE to place the burst vectors on their graticule marks (see Fig. 2-5).

3. Vector Presentation of Color Bars with Phase Lock from the Opposite Channel

a. Set the 1420 ϕ REF switch to A. Chrominance information in Channel B is now demodulated with reference to the subcarrier phase in Channel A. The display on the Vectorscope should be the same as illustrated in Fig. 2-5. Some phase jitter will be noticed in this mode of operation, because the Sync Stripper circuit does not receive or regenerate composite sync. Therefore, the H Regenerator free-runs at about 15 kHz, but not at exact line sync time. As a result, timing signals generated with reference to the H Regenerator are not exact.

4. Display of Subcarrier Signal

a. Set the 1420 INPUT switch to SUBCARRIER (A INPUT). Adjust the 1420 GAIN control to set the termination of the subcarrier signal on the graticule edge. Push the TEST CIRCLE button. This feature can be used to check vertical to horizontal gain match (see Fig. 2-6) and quadrature phase (see Fig. 2-7).

b. Set the 1420 ϕ REF switch to B. The subcarrier phase is now demodulated with respect to burst phase in the Channel B signal.

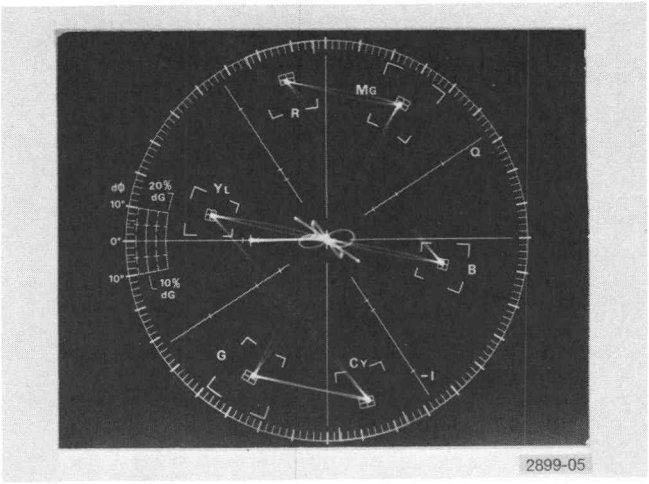

Fig. 2-5. 1420 NTSC color bars, 75% amplitude, 7.5% setup.

5. GAIN Control

a. Set the 1420 INPUT switch to B. Change the composite video input signal to a 5-step staircase, modulated with 140 mV of subcarrier. Rotate the 1420 GAIN control just out of the detent. The display is now about one-half original size and the UNCAL indicator is lit. Rotate the GAIN control to the counter-clockwise detent. The display is now back to original size and the CAL indicator is lit.

6. External Subcarrier Reference

a. Set up the equipment the same as in Steps 1 and 2, except set the ϕ REF switch to EXT. Note that there is no display except a dot in the center of the graticule.

b. Disconnect the subcarrier signal from the A INPUT and connect it to the EXT SUB INPUT. Note that the display is now phase-locked to the external subcarrier signal.

1421, 1422 CHECKOUT PROCEDURE

This procedure requires a video signal generator capable of providing composite video and subcarrier signals. In preparing this procedure, a TEKTRONIX 1411 Signal Generator with appropriate modules was used with the 1421 PAL Vectorscope and a TEKTRONIX 145-M was used with the 1422 PAL-M Vectorscope.

1. Setup

a. Set the PAL Video Signal Generator for standard PAL Colour Bars test signal; 75% amplitude, 0% setup.

b. Set the PAL-M Video Signal for standard PAL-M

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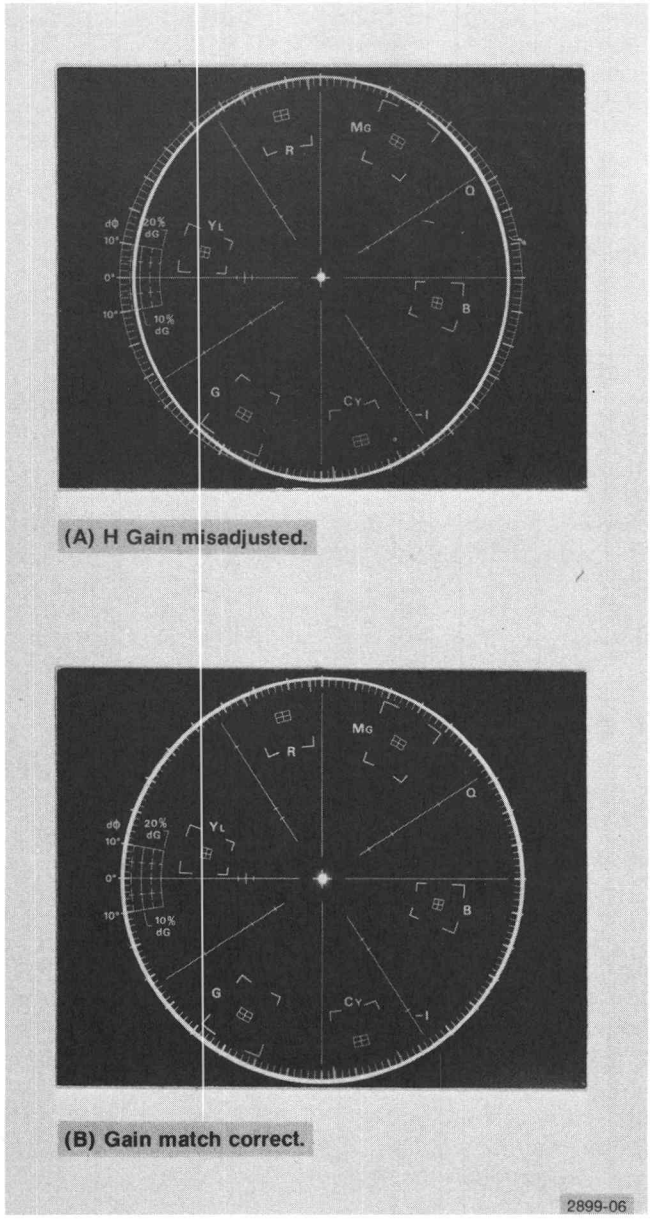

Fig. 2-6. 1420 — Checking the horizontal to vertical gain match.

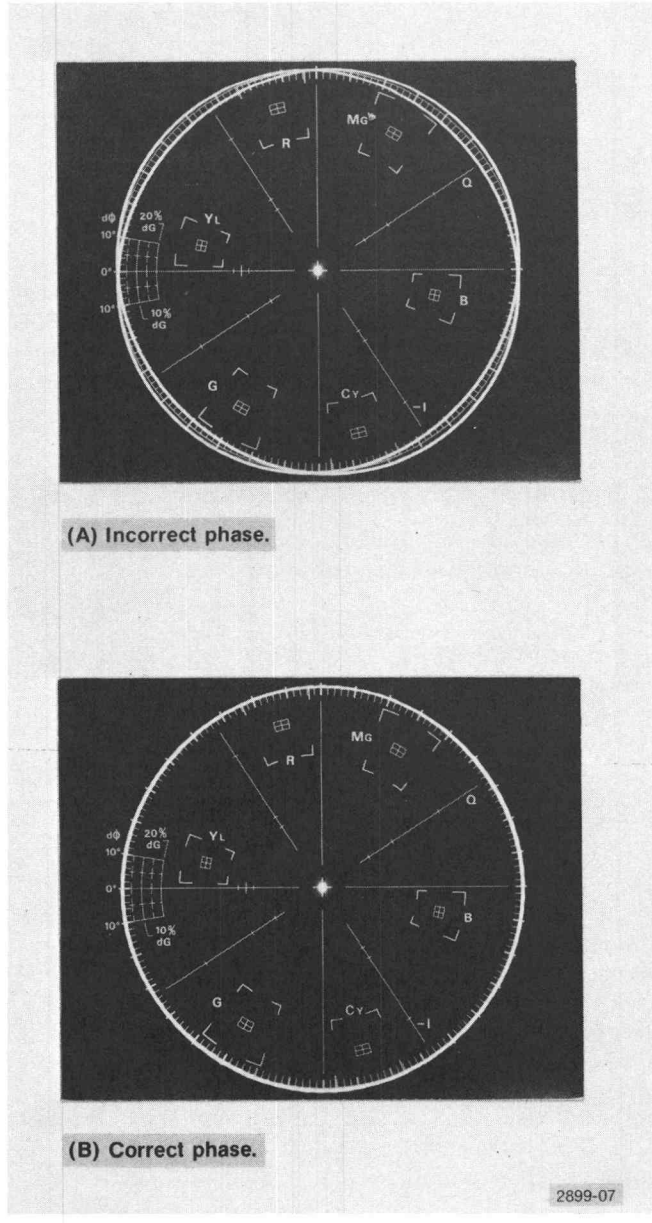

Fig. 2-7. 1420 — Checking quadrature phase.

Colour Bars test signal; 75% amplitude, 50 mV setup, 100% white reference.

c. Set the Vectorscope controls as follows:

GAIN	CAL
PHASE	Anywhere
ϕ REF	B VECTOR PAL
INPUT	B
INTEN	ccw
EXT SUB	INT
FOCUS	midrange
VERT POS	midrange
HORIZ POS	midrange
POWER	off

d. Connect the composite video from the video signal generator to the Vectorscope B INPUT. Terminate the B INPUT loop-through in 75 Ω.

e. Connect the subcarrier from the video signal generator to the Vectorscope A INPUT. Terminate the A INPUT loop-through in 75 Ω.

NOTE

Check the line voltage information indicated on the rear panel. If the power source voltage is not within the factory-set range, have a qualified service per-

son change the voltage operating range of the instrument. The necessary information is in the Service Information section of this manual.

f. Connect the Vectorscope to a suitable power source.

g. Set the Vectorscope POWER switch ON. Check that the front-panel CAL lamp is lit. Check that the SCALE ILLUM control (concentric with POWER switch) varies brightness of the graticule. Allow 10 minutes warm-up before proceeding.

2. Vector Presentation of Colour Bars

a. Rotate the Vectorscope INTEN and FOCUS controls for a bright, well-defined display.

b. Rotate the VERT POS and HORIZ POS controls to center the display origin at graticule center.

c. Rotate PHASE to place the burst vectors on their graticule marks (see Fig. 2-3).

d. Set the Vectorscope ϕ REF switch to B VECTOR NTSC. The 180° switcher in the demodulator is now running, causing the −V burst and the chrominance vectors associated with it to be switched in phase and overlaid with the +V burst and chrominance. See Fig. 2-4. This feature is particularly useful in studio source phasing, where all input signals to the studio switcher can be displayed in turn, and phase errors removed by adjusting source phasing for overlay of the Vectorscope display. Source phasing, using this feature, also assumes accurate burst quadrature.

3. Vector Presentation of Colour Bars with Phase Lock from the Opposite Channel

a. Set the Vectorscope ϕ REF switch to A VECTOR PAL. Chrominance information in Channel B is now demodulated with reference to the subcarrier phase in Channel A. The display on the Vectorscope should be the same as illustrated in Fig. 2-3. Some phase jitter will be noticed in this mode of operation, because the Sync Stripper circuit does not receive or regenerate composite sync. The H Regenerator free-runs at about 15 kHz, but not at exact line sync time. As a result, timing signals generated with reference to the H Regenerator are not exact.

4. Display of Subcarrier Signal

a. Set the Vectorscope INPUT switch to SUBCARRIER (A INPUT). Adjust the Vectorscope GAIN control to set the termination of the subcarrier signal on the graticule edge. Push the TEST CIRCLE button. This feature can be used to check vertical to horizontal gain match (see Fig. 2-8) and quadrature phasing (see Fig. 2-9).

b. Set the Vectorscope ϕ REF switch to B VECTOR PAL. The subcarrier phase is now demodulated with respect to burst phase in the Channel B signal.

5. GAIN Control

a. Set the Vectorscope INPUT switch to B. Change the composite video input signal to a 5-step staircase, modulated with 140 mV of subcarrier. Rotate the Vectorscope GAIN control just out of the detent. The display is now about one-half original size and the CAL light is not lit. Rotate the GAIN control to the clockwise stop. The display is now about five times original size. Rotate the GAIN control to the counterclockwise detent. The display is now back to original size and the CAL indicator is lit.

6. External Subcarrier and PAL Pulse Reference

a. Set up the equipment the same as in Steps 1 and 2, except set the Vectorscope EXT SUB switch to EXT. The EXT SUB lamp should light. Note that there is no display except a dot in the center of the graticule.

b. Disconnect the subcarrier signal from the Vectorscope A INPUT, and connect it to the EXT SUBCARRIER REFERENCE input. Connect an External PAL Pulse (1 to 5 V p-p negative-going pulse) to the EXT PAL PULSE input. Terminate the other two loop-through inputs in 75 Ω. Note that there is a display, and it is now phase-locked. Setting the EXT SUB switch back to INT returns the Vectorscope to the normal operating modes and also extinguishes the EXT SUB light.

OPERATOR'S FAMILIARIZATION

BASIC INFORMATION

In color television the visual sensation of color is described in terms of three qualities: luminance, hue, and saturation. Figure 2-10 shows a conical representation of these concepts.

Luminance. Luminance is brightness as perceived by the eye. As the eye is most sensitive to green and least to blue light of equal energy, green is a bright color and blue is a dark color as conveyed by the luminance signal to monochrome TV receivers.

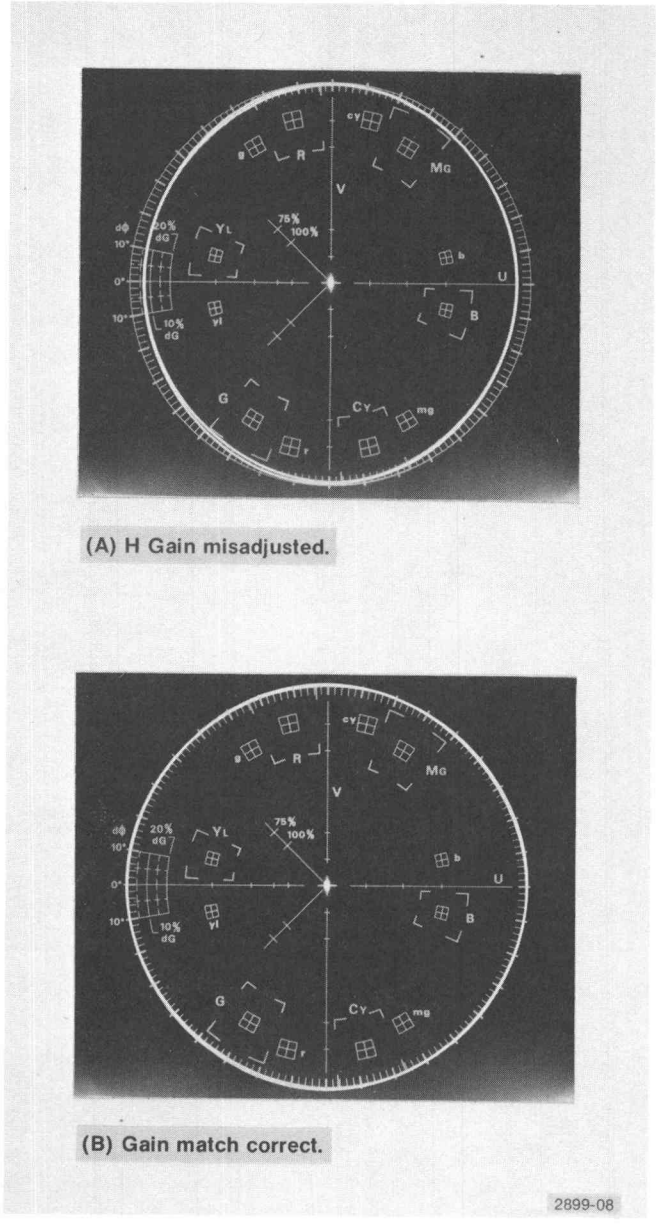

Fig. 2-8. 1421, 1422 — Checking vertical to horizontal gain match.

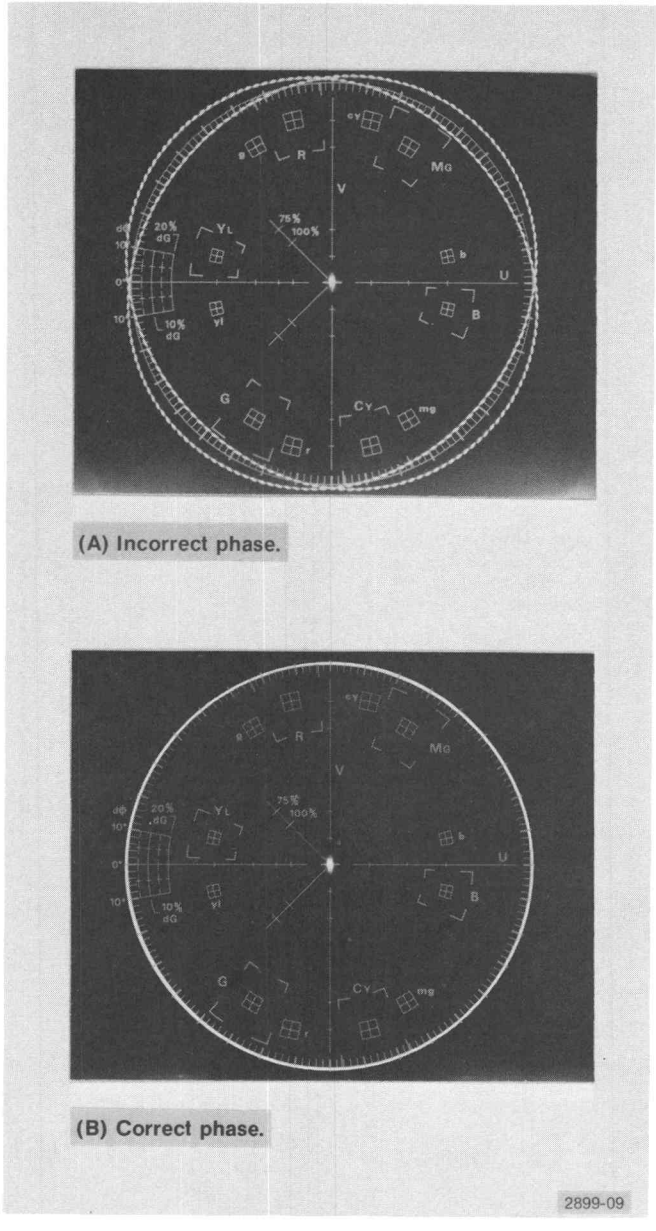

Fig. 2-9. 1421, 1422 — Checking quadrature phase.

Chrominance. Chrominance consists of two additional quantities: hue and saturation. Hue is the attribute of color perception that determines whether the color is red, blue, green, or the like. White, black, and gray are not considered hues. Hue is presented on the Vectorscope CRT as a phase angle and not in terms of wavelength. For example, red, having a wavelength of 610 millimicrons, is indicated as 104° on the standard color phase vector diagram when the burst is at 180° for NTSC and 135° for PAL and PAL-M. The standard color-phase vector diagram is shown in Fig. 2-11 for NTSC, and Fig. 2-12 for PAL and PAL-M.

Saturation is the degree to which a color (or hue) is diluted by white light in order to distinguish between vivid and weak shades of the same hue. For example, vivid red is highly saturated and pastel red has little saturation. Using the Vectorscope, saturation is the radial distance from the center (where zero saturation exists) to the end of the color vector where 75% or 100% saturation exists for a particular color. If burst vector amplitude corresponds to the 75% saturated marking (see Fig. 2-13 for NTSC and Fig. 2-14 for PAL and PAL-M), the colors are 75% saturated. If burst vector amplitude corresponds to the 100% marking, the colors are 100% saturated. The 100% markings are shown only on the 1421 and 1422.

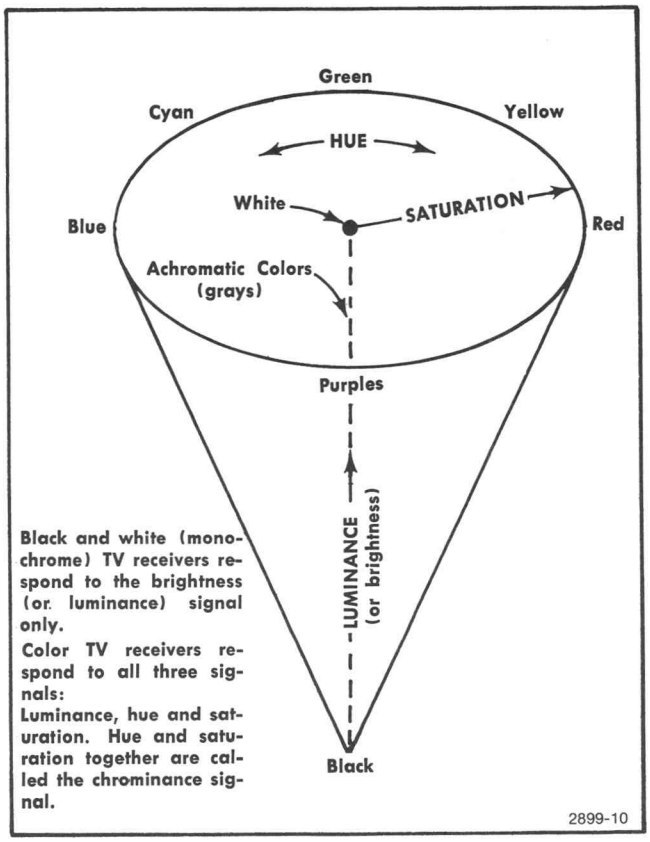

Fig. 2-10. Conical three-dimensional representation of color concepts.

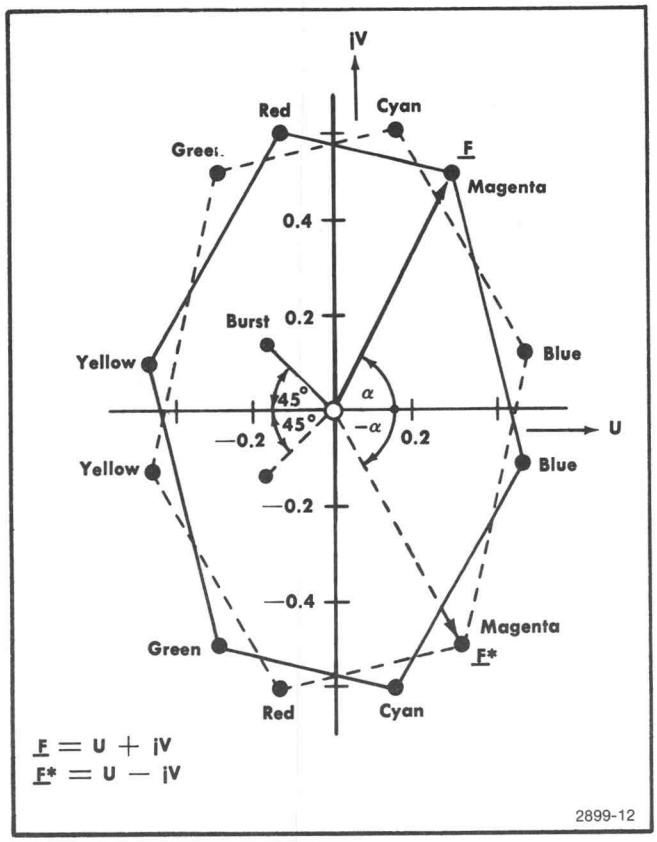

Fig. 2-12. PAL, PAL-M standard color-phase vector diagram.

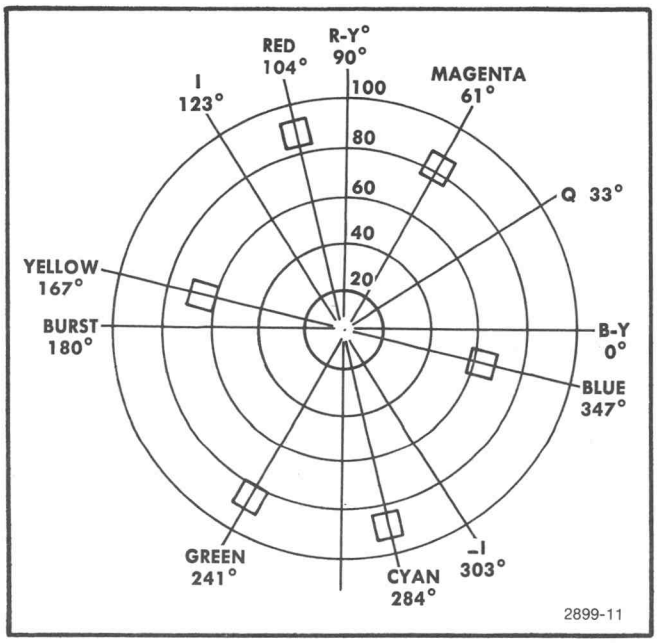

Fig. 2-11. NTSC standard color-phase vector diagram.

Encoding. The hue and saturation information in the color television system is carried on a single subcarrier frequency: 3.579545 MHz for NTSC, 4.43361875 MHz for PAL, and 3.575611 MHz for PAL-M. These signals, in modulated subcarrier form, are called chrominance. The hue information is carried by the subcarrier phase; the saturation information is carried by means of amplitude modulation with the subcarrier suppressed. A subcarrier which supplies phase information is required for demodulation. No chrominance signals are present during the horizontal blanking interval, and a sample of the subcarrier is provided within this interval and is called burst.

Decoding. To recover the hue information, phase demodulators are employed in the Vectorscope. The phase reference is the color subcarrier which is regenerated by an oscillator in the instrument. The oscillator is locked in both phase and frequency to the incoming color burst signal. The Vectorscope displays the relative phase and amplitude of chrominance signal on polar coordinates. To identify these coordinates, the vector graticule (see Fig. 2-13 for NTSC and Fig. 2-14 for PAL and PAL-M) has points which correspond to proper

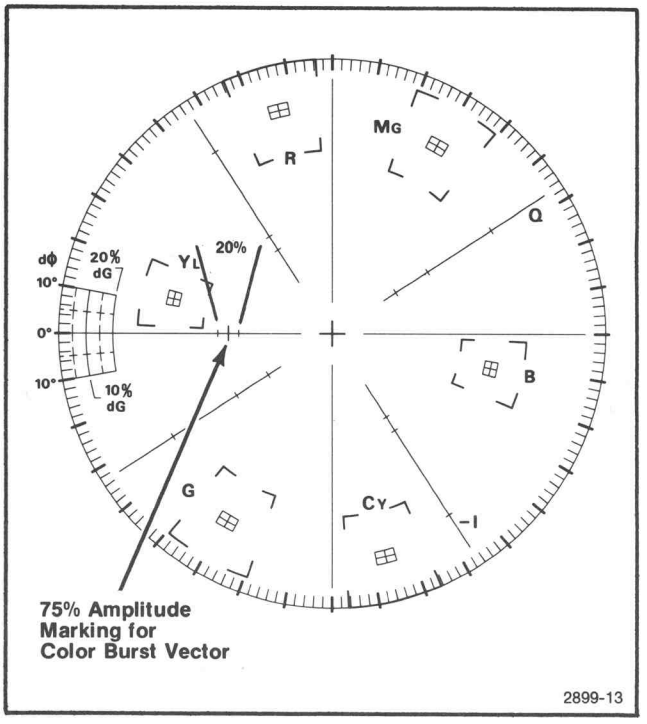

Fig. 2-13. 1420 burst markings.

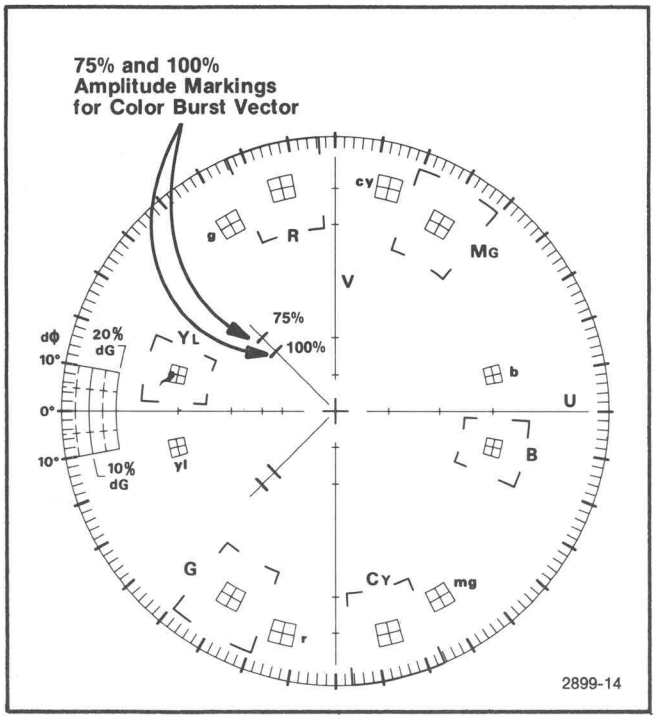

Fig. 2-14. 1421, 1422 burst markings.

phase and amplitude of the three primary colors related to the 180° burst vector for NTSC and the 135° burst vector for PAL and PAL-M: R (Red), B (Blue), and G (Green). The complements of the primary colors are indicated as follows: Cy (Cyan), Yl (Yellow), and Mg (Magenta). When the burst vector is at 225° for PAL and PAL-M, the conjugate color points are identified as follows: r (red), b (blue), g (green), cy (cyan), yl (yellow), and mg (magenta).

Any errors in the color encoding, video tape recording, or transmission processes which change these phase or amplitude relationships causes color errors on the television receiver picture. The polar-coordinate type of display such as that obtained on the 1420, 1421, or 1422 has proven to be the best method for portraying these errors.

FUNCTIONAL USE OF GRATICULE

Measurement of Color Bars

The polar display permits measurements of hue in terms of relative phase of the chrominance signal with respect to the color burst. Relative amplitude of chrominance to burst is expressed in terms of the displacement from center (radial dimension of amplitude) towards the color point which corresponds to 75% (or 100%) saturation of the particular color being measured.

On the graticule for the 1420, each chrominance vector terminates in a system of graticule markings in the shape of two boxes (a small box inside a large box). (See Fig. 2-15.) The dimensions of the large boxes represent ±10° centered on the exact chrominance phase, and ±20% of chrominance amplitude centered around 100% of standard amplitude (75% amplitude, 7.5% setup), while the dimensions of the smaller boxes represent ±2.5° and ±2.5 IRE.

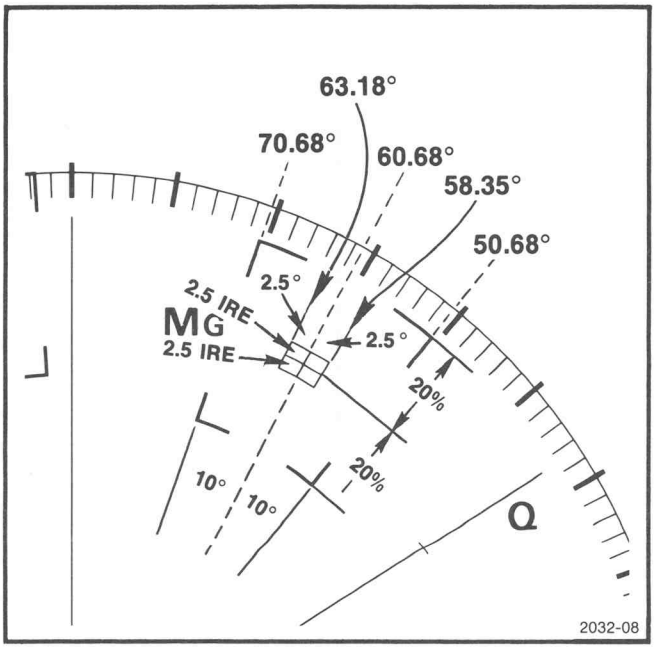

Fig. 2-15. 1420 graticule details, Magenta box.

On the graticule of the 1421 or 1422, each chrominance vector related to the +V burst terminates in a system of graticule markings in the shape of two boxes (a small box inside a large box). (See Fig. 2-16.) The dimensions of the large boxes represent ±10° centered on the exact chrominance phase and ±20% of chrominance amplitude centered around 100% standard amplitude (75% amplitude, 0% setup), while the dimensions of the smaller boxes represent ±3° and ±5% of chrominance amplitude. Note that the chrominance vectors associated with the −V burst are not terminated in boxes.

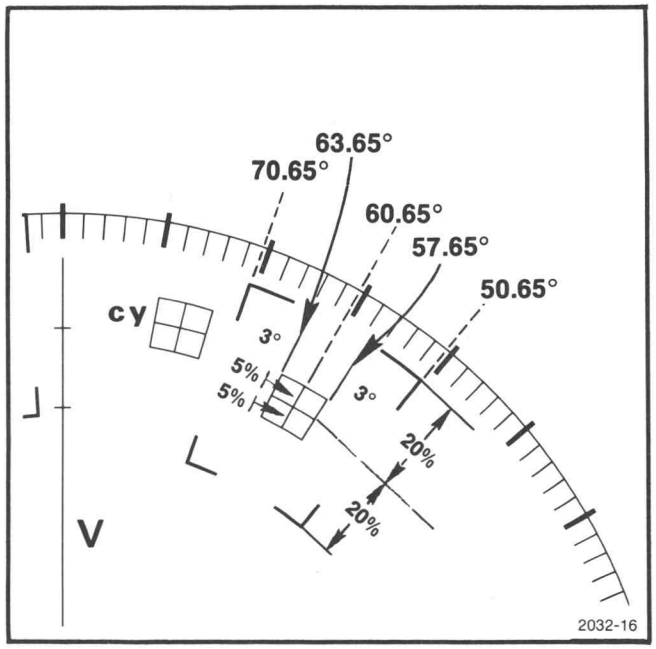

Fig. 2-16. 1421, 1422 graticule details, Magenta box.

Other graticule markings may be noted at this time. On the 1420, the small marks at intervals along the I and Q axes denote the amplitudes of the chrominance components as demodulated from a signal referenced to I and Q (see Fig. 2-17). On the 1421 and 1422, the small marks at intervals along the U and V axes denote the amplitudes of the U and V chrominance components (see Fig. 2-18).

Differential Gain and Phase Measurements

The two major distortions which the chrominance signal suffers are differential gain and differential phase. These distortions are chrominance non-linearities caused by luminance amplitude variations. Both can be measured

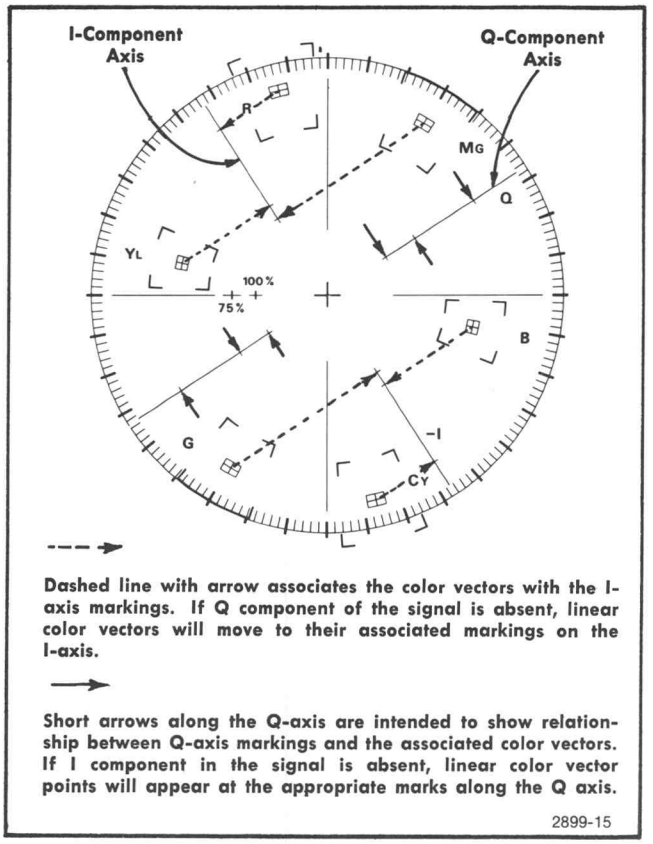

Fig. 2-17. Illustrating the purpose of the I and Q axis markings on the vector graticule.

on the Vectorscope. Differential gain is a change in color subcarrier amplitude due to a change in the luminance signal while hue and saturation of the original signal are held constant. In the reproduced picture, the saturation will be distorted in the areas between the light and dark portions of the scene. Differential phase is a phase change of the chrominance signal by the luminance signal while the original chrominance signal is held constant. In the reproduced picture, the hue will vary with scene brightness. Differential gain and differential phase may occur separately or together.

Differential gain (dG) and differential phase ($d\phi$) measurements can be made using the graticule markings located around the outer edge of the graticule at the termination of the B-Y axis for the 1420 and −U axis on the 1421 and 1422. See Fig. 2-19 for a differential gain measurement illustration and Fig. 2-20 for a differential phase measurement illustration.

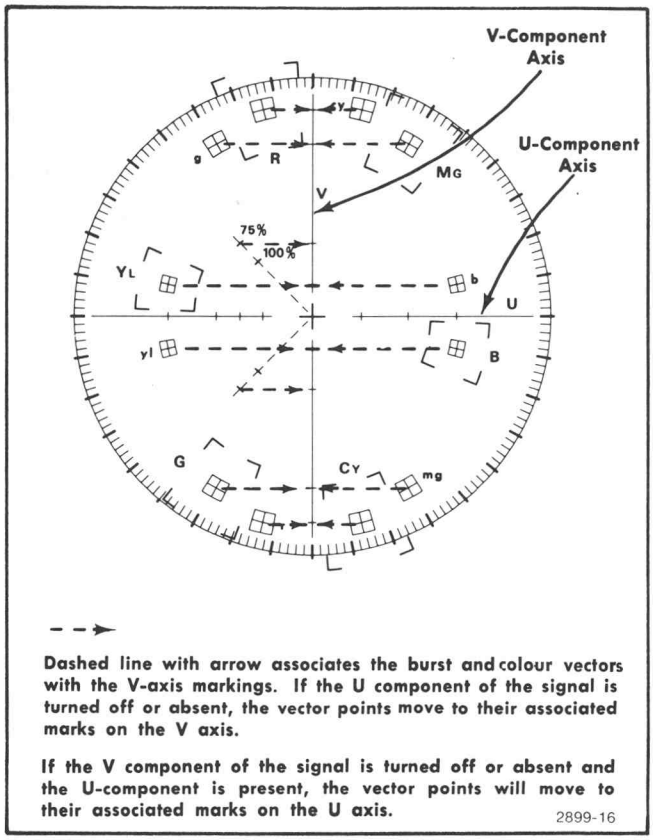

Fig. 2-18. Illustrating the purpose of the U and V axis marks on the vector graticule.

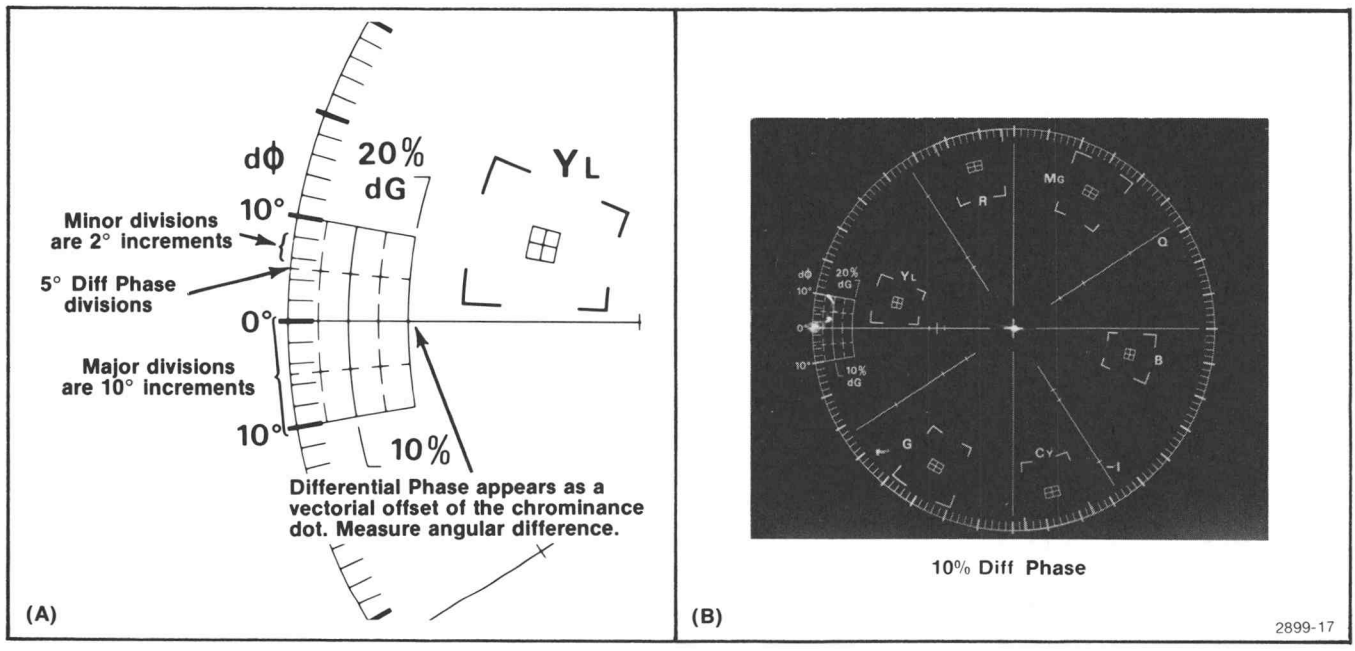

Fig. 2-19. (A) Differential Phase graticule markings; (B) Example of Differential Phase.

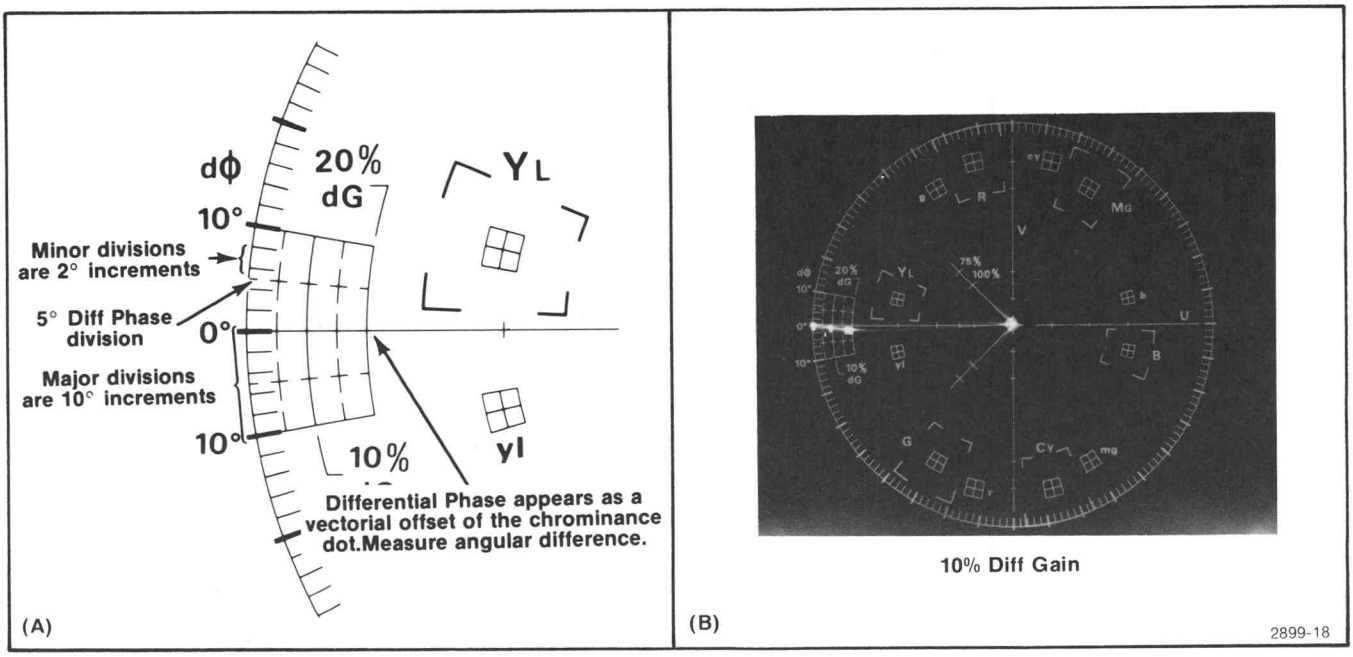

Fig. 2-20. (A) Differential Gain graticule markings; (B) Example of Differential Gain.

WARNING

THE FOLLOWING SERVICING INSTRUCTIONS ARE FOR USE BY QUALIFIED PERSONNEL ONLY. TO AVOID PERSONAL INJURY, DO NOT PERFORM ANY SERVICING OTHER THAN THAT CONTAINED IN OPERATING INSTRUCTIONS UNLESS YOU ARE QUALIFIED TO DO SO.

PART II

SERVICE INFORMATION

INSTALLATION

NOTE

At installation time, save the carton and packing materials for repackaging in case reshipment becomes necessary. See the Maintenance Section of this manual for repackaging instructions.

ELECTRICAL INSTALLATION

Operating Power Information

This instrument can be operated from either a 115 V or 230 V nominal line-voltage source, 48 to 66 Hz. In addition, three regulating ranges are provided for each nominal line-voltage source.

CAUTION

To prevent damage to the instrument, always check the line-voltage information indicated on the rear panel before applying power to the instrument.

Power Cord Information

WARNING

This instrument is intended to be operated from a single-phase earth-referenced power source having one current-carrying conductor near earth potential. Operation from power sources where both current-carrying conductors are live with respect to earth (such as phase-to-phase on a three-wire system) is not recommended, since only the Line conductor has over-current (fuse) protection within the instrument.

This instrument has a three-wire power cord with a polarized two-pole, three-terminal plug for connection to the power source and safety-earth. The safety-earth terminal of the plug is directly connected to the instrument frame. For electric-shock protection, insert this plug only in a mating outlet with a safety-earth contact.

Do not defeat the grounding connection. Any interruption of the grounding connection can create an electric-shock hazard. Before making external connections to this instrument, always ground the instrument first by connecting the power cord to a properly-mated power outlet.

Table 3-1

POWER-CORD CONDUCTOR IDENTIFICATION

Conductor	Color	Alternate Color
Line	Brown	Black
Neutral	Blue	White
Safety Earth	Green/Yellow	Green/Yellow

Line-Voltage and Regulating-Range Selection

CAUTION

Damage to the instrument may result from incorrect placement of the line-voltage selector plug.

To select the correct nominal line voltage and regulating range, proceed as follows:

1. Disconnect the instrument from the power source.

2. Insert the proper line-voltage selector plug (the brown plug for 115 V operation or the red plug for 230 V operation) on the line-voltage selector pins (located on the Power Supply board) labeled for the desired nominal line-voltage range. Refer to Fig. 3-1 for location and additional information.

3. Remove the line fuse from the fuse holder and check for the correct rating. Replace it with one having the correct rating, if necessary. Refer to the Fuse Data Chart on the back of the instrument.

4. Apply power to the instrument.

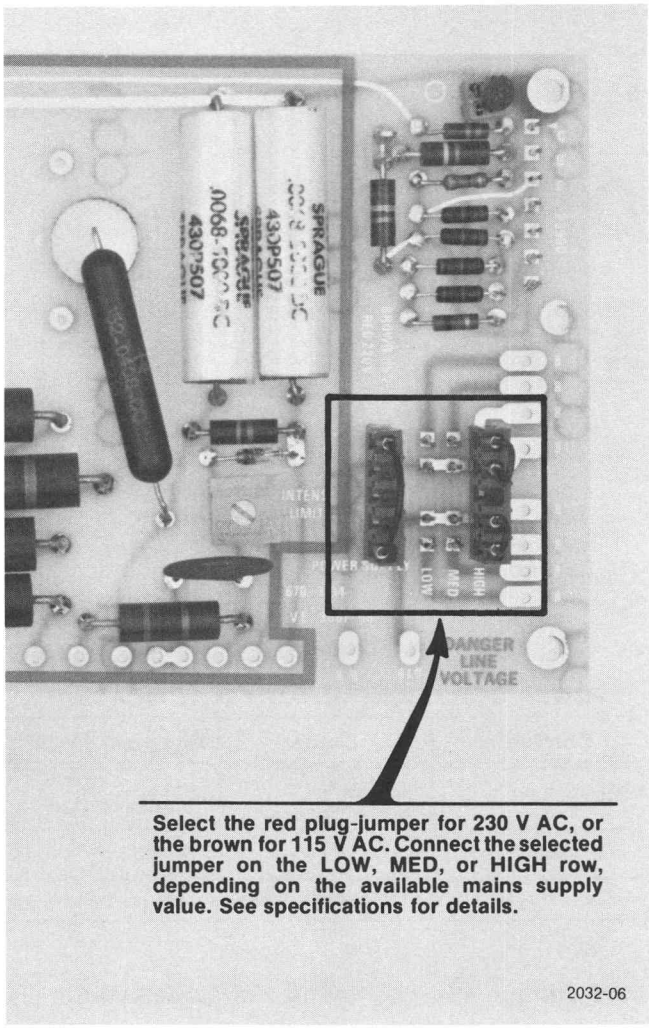

Fig. 3-1. Mains voltage and range selector.

PAL Pulse Phase

The Vectorscope will accept either +V (the 9-5 wire connected to pin 2 of P1600 on the Demodulator board) or −V phase (the 9-5 wire connected to pin 5 of P1600 on the Demodulator board). The phase is factory set for +V. By moving the wire from pin 2 to pin 5, you shift the phase of the pulse to the opposite line.

MECHANICAL INSTALLATION

Rackmounting Installation

The metal cabinet (Part No. 437-0100-01) provides the proper electrical environment for the instrument, minimizes handling damage and reduces dust collection within the instrument. The four 0.156-inch diameter holes in the bottom of the cabinet depressions provide a means for mounting the instrument solidly to a surface such as a metal shelf (rack adapter) in a cabinet rack or console.

The Vectorscope is designed to be cradle-mounted in a standard 19-inch rack or console side-by-side with a Type 528 or other instrument (see Fig. 3-2). The Tektronix Part No. for the rack adapter[1] to cradle-mount the instrument is 016-0115-02. If only one Vectorscope is mounted on the rack adapter, a panel assembly[1] that goes around the Vectorscope cabinet front dimension and covers the space for the other half of the rack width can be obtained by specifying Tektronix Part No. 016-0116-00.

Custom Installation

There are two possible ways to install the Vectorscope. The first way is to use the front dimensional view of the cabinet to cut an opening for the cabinet. The other way is to use the front dimensional view of the Vectorscope to cut an opening the same size as the outside dimension of the front sub-panel casting.

The first installation method allows the Vectorscope front sub-panel casting to cover the opening made in the custom panel. The second installation method requires a larger opening to allow the instrument to be positioned about 0.450 inch further back on the shelf to make the Vectorscope front panel surface align with the custom panel surface.

To install the instrument using the first method, the following procedure is suggested (refer to Fig. 3-3).

1. Remove the two securing screws from the rear of the cabinet and slide the instrument out through the front of the cabinet.

2. Cut the hole in the custom panel. Use the front dimensional view of the cabinet or the cabinet itself to determine the size of the opening.

3. Slide the cabinet through the rear side of the custom panel opening. Let the cabinet protrude through the front panel about 0.125 inch. (The front sub-panel casting on the Vectorscope has a groove to accept this amount of protrusion.)

4. Mark locations where the cabinet will be fastened to the shelf. (The bottom dimensional view drawing shows the 0.156-inch diameter hole locations in the cabinet.) Temporarily remove the cabinet; drill holes in the shelf.

5. Reinsert the cabinet through the custom panel opening. Fasten the cabinet to the shelf.

6. Insert the Vectorscope into the front of the cabinet. Secure the instrument to the cabinet by installing the two rear panel screws removed earlier.

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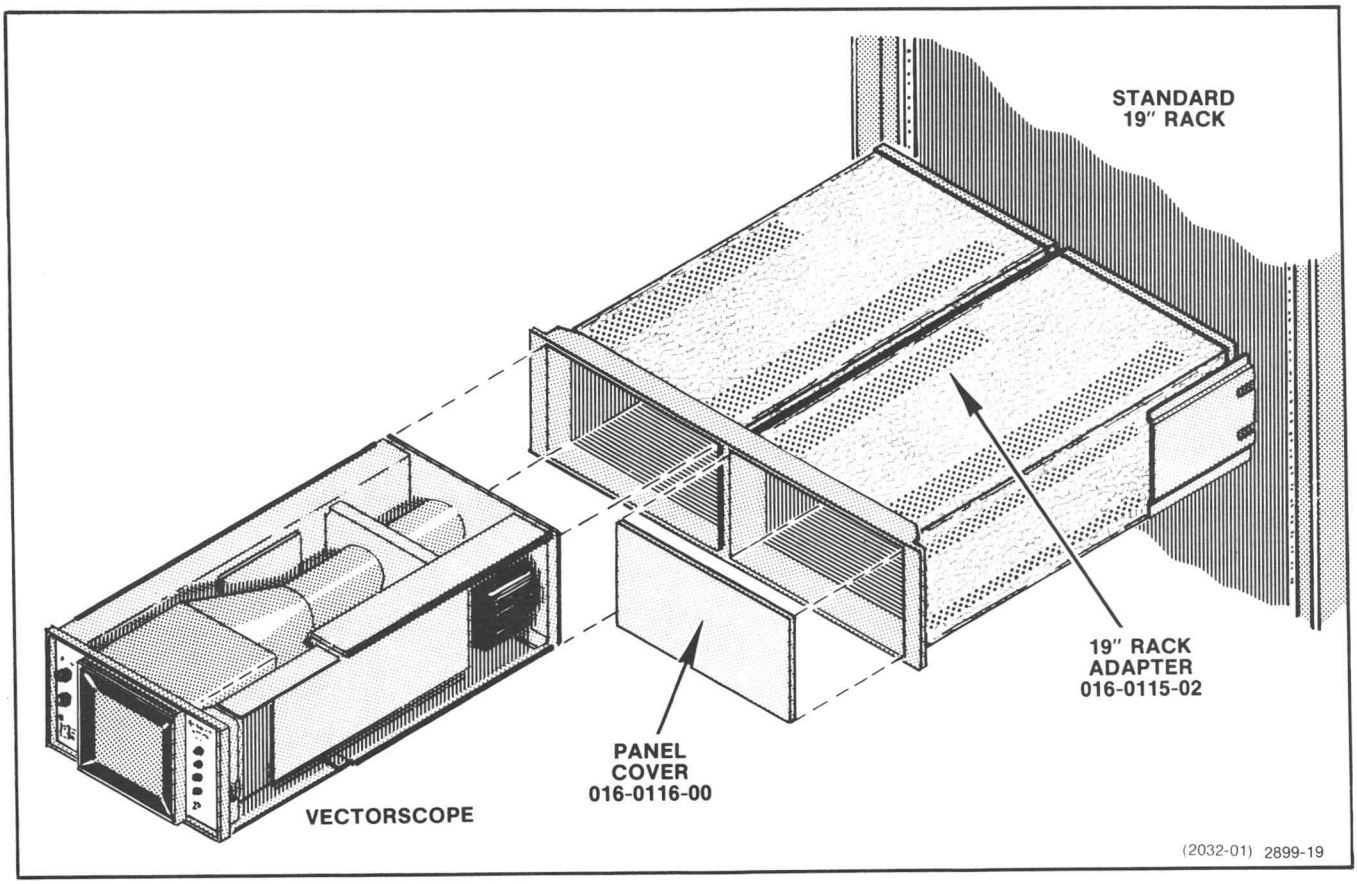

Fig. 3-2. Rack installation.

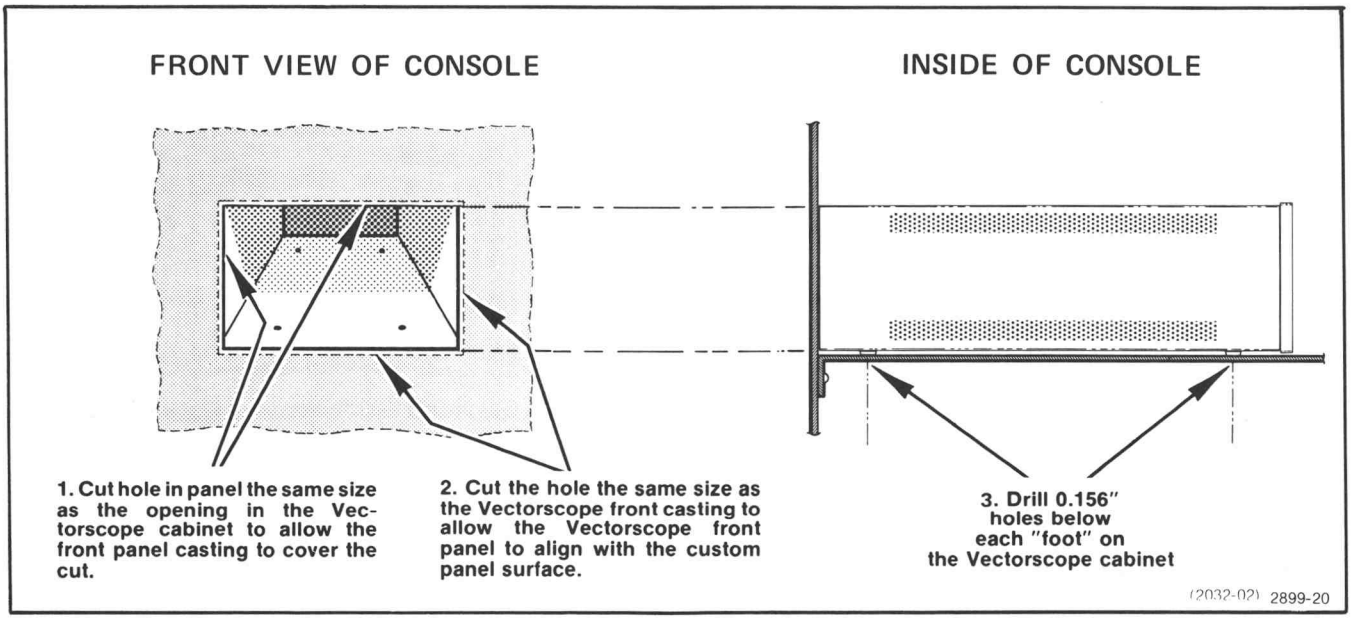

Fig. 3-3. Custom installation.

To install the instrument using the second method, the following procedure is suggested.

1. Measure the distance from the front edge of the Vectorscope front sub-panel casting to the center of the front mounting holes in the bottom of the cabinet. (This dimension should be about 1.750 inch.)

2. Remove the two securing screws from the rear of the cabinet and slide the instrument out through the front of the cabinet.

3. Cut the hole in the custom panel. Use the front dimensional view of the Vectorscope or use the rear casting on the cabinet to determine the size of the opening. Mark locations of front mounting holes for the cabinet. Then use the cabinet to mark rear hole locations for the cabinet and use the dimensional drawing as a guide in marking hole locations. Temporarily remove the cabinet; drill holes in the shelf.

4. Mark locations of front mounting holes for the cabinet. Then use the cabinet to mark rear hole locations for the cabinet and use the dimensional drawing as a guide in marking hole locations. Temporarily remove the cabinet; drill holes in the shelf.

5. Use parts 5 and 6 of the first method as a guide for completing the installation.

Portable Usage

For portable use, the Vectorscope can be removed from the rack or custom installation and slipped into a blue-vinyl aluminum field case. The field case[1] has a latch to hold the instrument in the case. In addition, the field case is equipped with a handle and rubber feet. Tektronix Part No. for the field case is 390-0018-01.

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[1] **All items can be ordered through your local Tektronix Field Office or representative.**

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THEORY OF OPERATION

This section includes a block diagram description and a detailed circuit description. The descriptions apply to all three Vectorscopes. Separate descriptions are given where circuit differences exist.

BASIC BLOCK DIAGRAM

The following discussion is provided to aid in understanding the overall concept of the Vectorscope's operation. A basic block diagram is shown in Fig. 4-1.

Input Amplifier

Composite color video information or cw subcarrier is fed through the Channel A or Channel B input connectors to the Input Amplifier. The Input Amplifier has two different outputs. One is chrominance information to the Demodulators from the input channel selected by the front-panel INPUT switch. The other output is composite video or cw subcarrier to the Subcarrier Regenerator and the Horizontal Regenerator. This signal is selected from one of the two channel inputs by the ϕ REF switch on the front panel.

Horizontal Regenerator

The H Regenerator removes the video information, using the resultant sync pulses to synchronize the horizontal pulse oscillator. The horizontal pulses regenerated by the Horizontal Regenerator drive the 180° Phase Switcher and the Clamp and Gate Generator. The Horizontal Regenerator will free-run at approximately 15 kHz if no horizontal pulses are present.

Subcarrier Regenerator

The Subcarrier Regenerator provides continuous subcarrier information from an oscillator phase-locked to incoming burst or cw subcarrier. This continuous subcarrier is fed to the Demodulators. If no reference is available for the oscillator, it will free-run. When the Vectorscope is in the External Subcarrier mode of operation, the continuous subcarrier information applied to the EXT SUBCARRIER REFERENCE Input is applied to the Demodulators and the internal oscillator is disabled. Also, the Subcarrier Regenerator provides an error signal for the PAL Preset on the 1421 and 1422, when in the internal ϕ REF mode.

PAL Preset and EXT PAL Amplifier

For the 1421 and 1422, two additional basic blocks are added to the instrument. They are the PAL Preset and the EXT PAL Amplifier. When the PAL or PAL-M Vectorscope's ϕ REF switch is in the NTSC position, one or the other of these two blocks of circuitry supplies the 180° Phase Switcher with PAL Pulses. In the internal reference mode of operation, the PAL Preset block is functioning, and the EXT PAL Amplifier is operating in the external reference mode of operation. The PAL Pulses align the 180° Phase Switcher to overlay the −V burst vector and its associated vectors on the +V burst vector and its associated vectors.

Demodulators

The R-Y (V) and the B-Y (U) Demodulators are used to extract the color information from the input chrominance signal. The two demodulators function the same except 90° out of phase from each other. The R-Y (V) color information is used to drive the vertical deflection plates of the crt, while the B-Y (U) color information is used to drive the horizontal deflection plates.

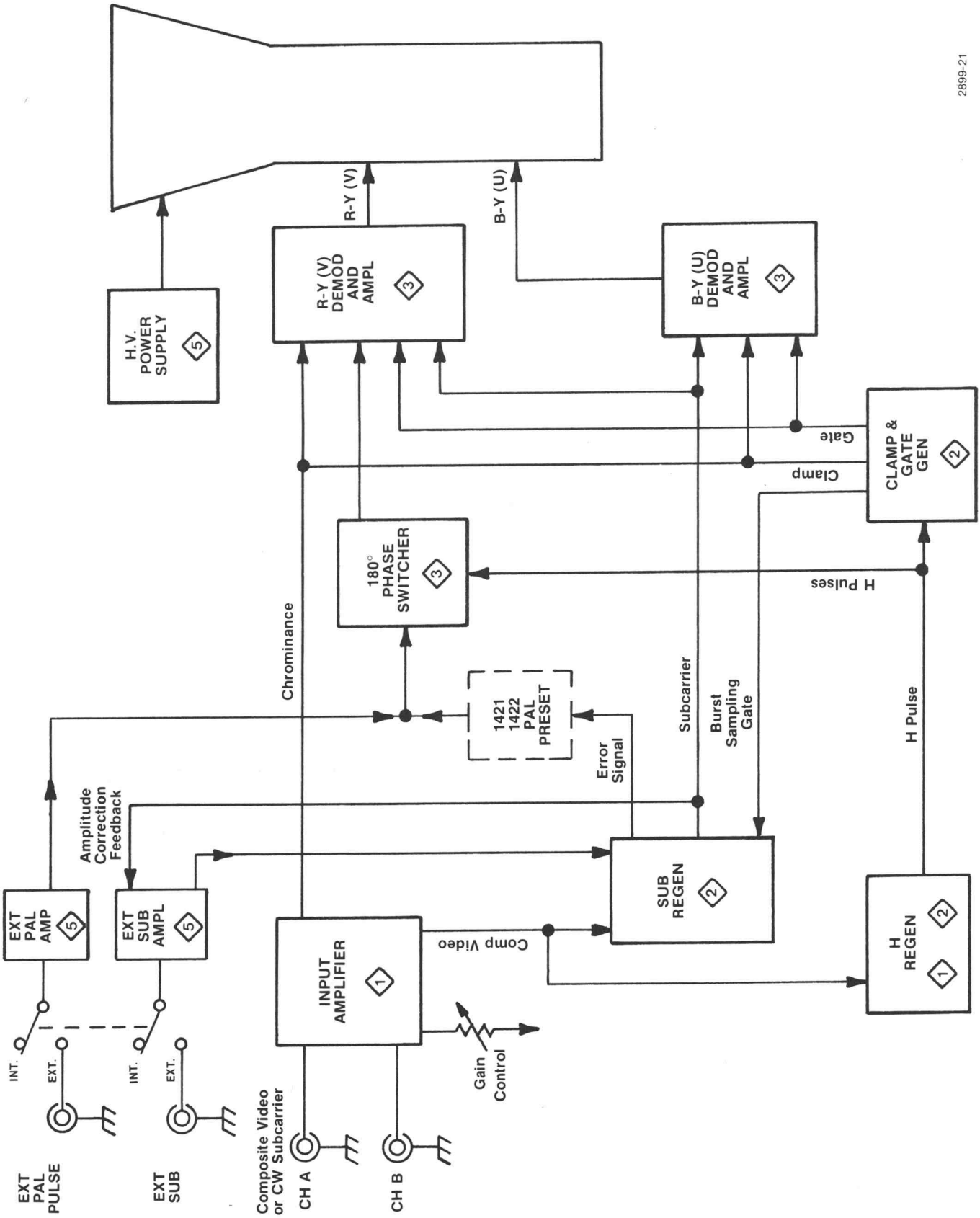

Fig. 4-1. Basic block diagram.

DETAILED CIRCUIT DESCRIPTION

DIAGRAM 1 INPUT PROCESSING

Input Amplifier

Q1032, Q1034, and Q1036 form a non-inverting operational amplifier with a gain of one. The Channel A signal drives the gate of Q1032. The output is the emitter of Q1036. Likewise, Q1082, Q1084, and Q1086 form a non-inverting, unity gain operational amplifier for the Channel B signal. This amplifier is identical to the Channel A Input Amplifier.

The output of Channel A Input Amplifier drives a switching network consisting of Q1110-CR1110, Q1120-CR1122, and Q1140-CR1148; while the output of Channel B Input Amplifier drives a switching network consisting of Q1160-CR1164 and Q1180-CR1168. These networks route the input signals, according to the position of the INPUT and ϕ REF switches.

Switching

Signal routing through the switching network is controlled by the INPUT and ϕ REF switches. The INPUT switch controls the transistors Q1110, Q1120, and Q1160 in allowing chrominance information to pass on to the Demod Driver. The ϕ REF switch controls the transistors Q1140 and Q1180 in allowing incoming signals to drive the sync and timing circuitry.

The INPUT switch grounds the base of Q1120 in the A position. This allows the chrominance portion of the input signal to Channel A to pass through the filter and Gain Cell to the Demod Driver. The other switching transistors (Q1110 and Q1160) are saturated, grounding the signal at their collectors. The time constant of C1120-R1020 allows only chrominance information to pass.

With the INPUT switch in the B position the base of Q1160 is grounded, allowing the chrominance portion of the incoming signal to Channel B to pass through the switching network. Moving the INPUT switch to the SUBCARRIER (A INPUT) position grounds the base of Q1110 and allows chrominance, reduced in amplitude, from the incoming signal on Channel A to pass through the switching network. The reduced amplitude of chrominance is due to the time constant of C1010-R1012.

Signal routing through the switching network is also controlled by the ϕ REF switch, which grounds the base of Q1140 in the A position and the base of Q1180 in the B position. The result is: in the ϕ REF A position the incoming signal on Channel A drives the sync and timing circuits, while in the ϕ REF B position the incoming signal on Channel B drives the sync and timing circuits.

When the ϕ REF is in the EXTERNAL position (EXT of the EXT SUB switch on 1421 and 1422), the INPUT switch controls the switching of Q1140 and Q1180. When the INPUT switch is in the A position, the base of Q1140 is grounded, allowing the signal on Channel A to pass to the timing circuitry. Likewise, when the INPUT switch is in the B position, the base of Q1180 is grounded, allowing the signal on Channel B to pass on the timing circuitry. The INPUT switch in the SUBCARRIER (A INPUT) position allows neither Channel A or B signal to pass.

Gain Cell and Control

Gain Cell. The chroma signal from the signal switching network drives Input Phase Matching, L1118 and L1178, and Q1201, a buffer amplifier. The output of Q1201 drives a Gain Cell composed of CR1304, C1303, and CR1401.

The signal current available for the amplifier is determined by the relative conduction of these two diodes. CR1304 has a fixed current of 0.6 mA. The current in CR1401 is variable from the Gain Cell Control circuit. If CR1401 is conducting heavily, more signal current is shunted to ground than passes through to the amplifier, and the amplifier gain is relatively low. If CR1401 is not conducting heavily, more signal current passes through to the amplifier, and the amplifier gain is relatively high.

Gain Control. The current source for CR1401 with the front-panel GAIN control in the CAL position is Q1502. Q1512 is biased on by its fixed base bias to ground and its emitter return to +15 V through R1507. Q1502 is saturated and CR1413 is reverse biased. The internal Cal Adj, R1403, determines the amount of current available for CR1401.

When the front-panel GAIN control is in the variable position, CR1413 is turned on and Q1512 is turned off by the −15 V applied through the Var Gain control, R222 and R1503. Q1502 is turned off by the lack of current through Q1512. CR1413 then becomes the current source for CR1401, with the current set by the front-panel GAIN control.

Lamp Switch (1420)

Q1801 is normally off. The front-panel GAIN switch ground provides a current source for the front-panel CAL lamp. When the GAIN control is switch out of detent, the base of Q1802 is biased on by current through the CAL lamp. Q1801 becomes the current source for the front-panel UNCAL lamp.

CAL Lamp (1421, 1422)

When the front-panel GAIN control is switched out of detent, S222 (GAIN switch) grounds one side of the CAL lamp, DS210. Current then flows through the lamp and R1505 to the −15 V supply (see Diagram 5, Sub Ref & Switching).

Demodulator Driver

Q1318, Q1410, and Q1412 form an inverting operational amplifier in a transresistance amplifier configuration. In a transresistance amplifier, the output voltage is directly proportional to the input current.

The input current to the amplifier is composed of fixed bias current through R1305 and CR1304, and the signal current. More or less signal current can be shunted away from the amplifier by the gain cell diode CR1401, as discussed previously.

The output voltage at the emitter of Q1412 is determined by the instantaneous input current times R1415, the feedback resistor. The output of the Demodulator Driver drives the signal inputs of the two demodulators on Diagram 3.

Sync Stripper

The Sync Stripper receives composite video and "strips" and regenerates the sync pulses. Sync pulse regeneration removes sync tip tilt and 60 Hz hum and also provides a constant amplitude sync pulse output because of the automatic gain control feature of the cirtuit. See Fig. 4-2 for a block diagram of the Sync Stripper.

Composite video from the Video Switching network drives the Sync Stripper input amplifier through R1276, to the emitter of Q1372.

The Sync Stripper input amplifier is an inverting operational amplifier composed of Q1372, Q1253, and Q1364. Q1253 inverts the input signal and drive summing amplifier, Q1222. The feedback loop around Q1372 and Q1253 is a low-pass filter (C1364 and Q1364) that provides negative feedback to 60 Hz signals, effectively reducing 60 Hz hum.

R1366 and C1373 form a high-pass filter that changes the gain of the summing amplifier from 1 at very low frequencies to 3 above approximately 200 Hz. This allows faster recovery of the sync tip level.

The summing amplifier, Q1222, drives emitter follower, Q1233, with inverted (sync positive). Q1322 drives three comparators: Blanking Level, CR1255-Q1355; Sync 50% Level, CR1244-Q1348; and Sync Tip, CR1325-Q1342. During active video time, the diodes in the three comparators are conducting.

When the positive-going sync pulse at the emitter of Q1233 rises past the anode of CR1235, the Sync Tip comparator switches, clamping the sync pulse tip at that point. Collector current in Q1342 charges the sync tip level memory capacitor C1333. The stored charge on C1333 is applied through emitter follower Q1227, to the summing amplifier, Q1222, which demands more or less current from the Input Amplifier, setting the sync tip level at the emitter of Q1233. The Sync Tip comparator is rate-limited by C1333 so that impulses will not shift the sync tip level.

Any sync tip tilt present on the incoming video is eliminated as soon as the sync tip comparator switches, because the sync regeneration that takes place at the collector of Q1345 is isolated from the incoming video by the comparator.

CR1335 provides some current during sync time, allowing C1333 to slew negative if the sync tip is not far enough positive to turn CR1235 off.

The Sync 50% Level comparator switches at the half-amplitude point of the sync pulse at the emitter of Q1233. Collector current in Q1348 saturates Q1345, producing a 10 V pulse at the collector of Q1345 of the same width and polarity as incoming sync. This stripped sync pulse is decreased in amplitude through divider R1315 and R1312, and coupled to the base of Q1332, the input to a Bowes oscillator. The pulse also gates CR1335 on, providing current to the sync tip comparator during sync time.

The Blanking Level Comparator is biased to switch about halfway between the setup level and the blanking level. This comparator provides gain drive for the total circuit, determined by the length of time it charges C1361.

The charge on C1361 sets the bias on the base of Q1362, the AGC control. Q1362 carries part of the collector current for Q1372—the other part of this current is base current for Q1253.

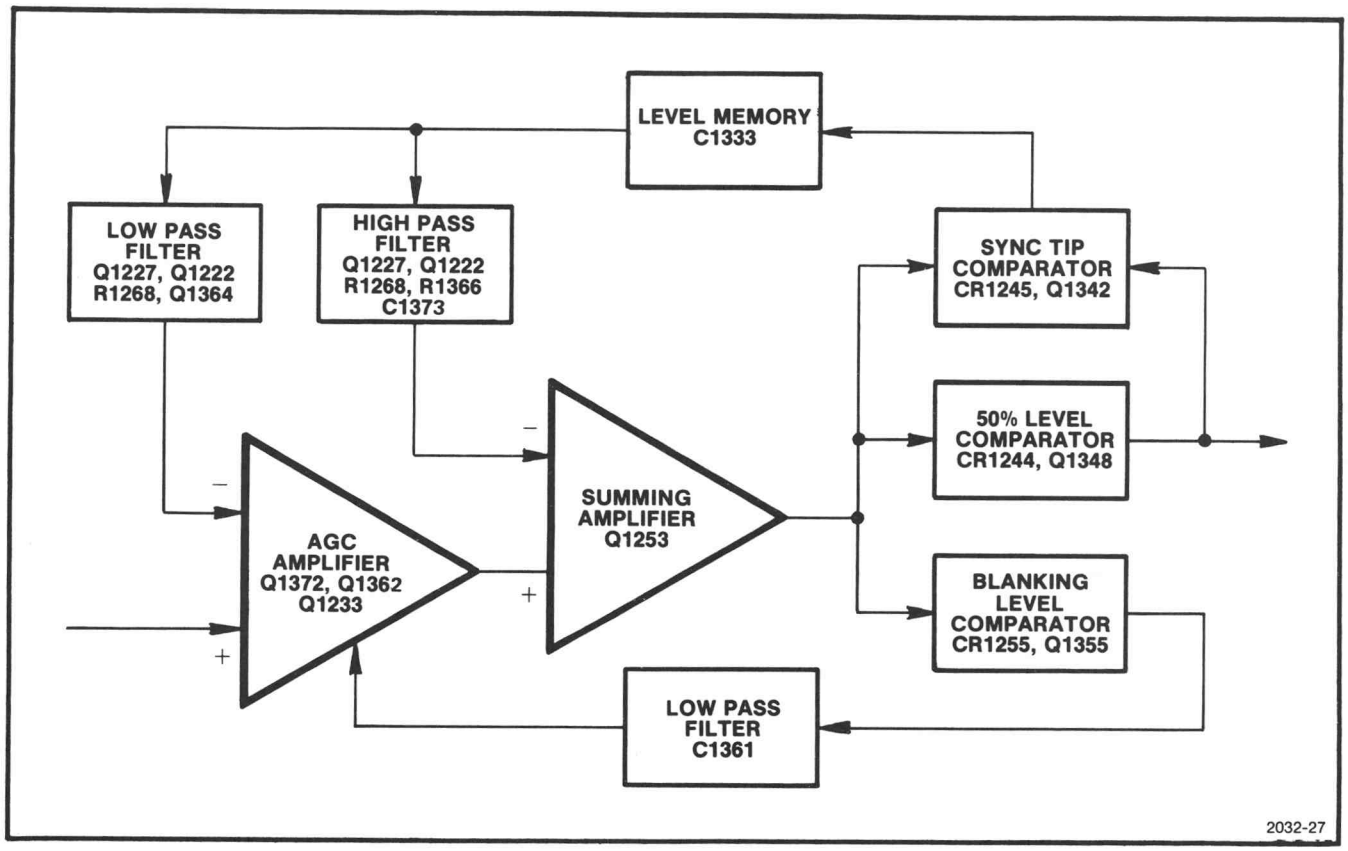

Fig. 4-2. Sync Stripper block diagram.

If the input signal amplitude to the Sync Stripper is low, the Blanking Level Comparator switches at a point closer to setup than to blanking. As a result, Q1335 conducts for a longer period of time than it would if the input were correct. The longer period of conduction charges C1361 more positive, decreasing current through Q1362. This forces more base current in Q1352, increasing circuit gain. If the input signal amplitude is high, the opposite condition prevails.

The collector of Q1345 (output of the Sync Stripper) drives the base of Q1332, the input to an emitter-coupled oscillator on Diagram 2.

DIAGRAM 2

PHASE LOCK & TIMING

H Regenerator

Q1332 and Q1432 forms a Bowes oscillator that regenerates horizontal-rate sync, locking out any twice-horizontal-rate signals such as vertical serrations and equalizing pulses. Output pulse width is determined by R1346 and C1346, while time between pulses is determined by R1339 and C1346. The output signal is a 5 V negative-going H-rate pulse with the pulse tip near −1.2 V.

The H Regenerator oscillator free-runs, if the input signal is non-composite, to provide the necessary clamping signals.

The H Regenerator output is applied through emitter follower Q1433 to the Sync Tip Clamp Generator, the Sampling Gate Generator, and the Burst Sampling Timing circuits, and as a clock to the 180° Phase Switcher in the Demodulators on Diagram 3.

Sync Tip Clamp Generator

The H Regenerator signal drives the base of Q1865, which inverts and amplifies the signal and applies it to the base of Q1739, the Demodulator Input Clamp on Diagram 3. The output of the Sync Tip Clamp Generator is a positive-going horizontal-rate pulse of about 10 V amplitude, with the pulse tip at about +5 V. The negative excursion of the signal is caught at −5 V by the reverse breakdown of the base-emitter junction of Q1739 on Diagram 3.

Sampling Gate Generator

Q1963 is turned on by the output of the H Regenerator, but the leading edge of the drive pulse is delayed by R1974

and C1970. This delay causes the signal at the collector of Q1963 to start negative about 1.5 μs after the emitter signal starts negative.

The collector of Q1963 drives the base of Q1973, turning Q1973 off. The base of Q1973 rises to turn-on potential after a time determined by R1977-C1972.

The output of the Sampling Gate Generator is a positive-going 2.4 μs gate-pulse that provides 1 mA of amplifier bias current to each of the Demodulator Output Amplifier Clamps. The clamps sample at the time of this gate (approximately the center of line sync).

Burst Sampling Timing

When the negative-going H Regenerator output signal arrives at the base of Q1595, it is delayed about 0.5 μs by R1588-C1592. The delayed pulse is inverted and amplified by Q1595, and applied through C1571 to the base of Q1570.

The slowly rising leading edge of the signal has no effect on Q1570, since it is normally on. The trailing edge, however, turns Q1570 off. Because of the delay at the base of Q1595, Q1570 is turned off slightly after the trailing edge of line sync. Q1570 turns on after a period of time determined by R1565-C1571, providing a positive-going pulse during burst time. This pulse, during burst time, is applied to the Phase Detector as the Burst Sample Gate.

Chroma Amplifier

Q1397 and Q1398 form an operational amplifier that is driven by the chrominance portion of the input signal through high-pass filter L1290-C1395.

The output of the Chroma Amplifier is the resultant of the bias current through R1390, modulated by signal current through the high-pass filter, across feedback resistor R1389. This amplified chrominance is applied through C1482 to the input of the Limiter Amplifier, Q1472 A and B.

Limiter Amplifier

Q1472 A and B form a non-inverting emitter-coupled amplifier with gain limited to 4 mA across the parallel combination of R1387-R1473. The output is four volts peak-to-peak chrominance that is coupled through two emitter followers (Q1359 and Q1462) to the Phase Detector transformer, T1465.

Phase Detector

Chrominance from the Limiter Amplifier is applied to the primary of T1465. The secondary of the transformer is switched by Q1476 and Q1477 so that opposite ends of the windings are alternately grounded at a subcarrier rate. The switching signals are derived in Q1584 and Q1573. The common emitters of this switch are driven by the Burst Sampling Gate from the Burst Sampling Timing circuit. The base of Q1584 is driven by subcarrier from the Subcarrier Oscillator through emitter follower Q1579. Since Q1584 and Q1573 are enabled at the same time by the Burst Sampling Gate, the subcarrier at the base of Q1584 is emitter coupled through Q1573. The signals at the collectors of these two transistors are then 180° out of phase, causing Q1476 and Q1477 to saturate at opposite polarities of the subcarrier cycle.

The center of the secondary of T1465 is the Phase Detector output. The two secondaries are phased 180° apart so that on alternate subcarrier half-cycles the signal at their junction will be shifted 180°. At the same time the secondaries are switched, the burst being sampled also goes through 180° of phase. The result, at the Phase Detector output, is full-wave rectification of the burst. (See Fig. 4-3, NTSC; Fig. 4-4, PAL.) The rectified burst is filtered by R1560 and C1564 and applied to the inputs of a band switch (U1540A) and a voltage follower (U1540B).

The charge on C1564 is retained over the entire video line because there is no discharge path for it except during burst time. The inputs to U1540A and B are high impedance, and Q1476 and Q1477 are off except during burst time.

The second primary winding on T1465 provides reactive shielding for one of the secondary windings. The transformer coils are wound with primary windings on the outside and the two secondary windings on the inside. The second primary winding is 180° from the first primary, and physically located next to the like-phased secondary. This configuration eliminates the need for phase compensation at the input to the Error Amplifier.

Error Amplifier

U1540B (a voltage follower), U1540A and Q1543 (a band switch), and U1548 (an inverting amplifier) form the Error Amplifier circuit.

The output of the Phase Detector drives U1540B pin 5. Since U1540B is connected as a voltage follower, a signal identical to the input signal drives U1548's input resistor, R1551.

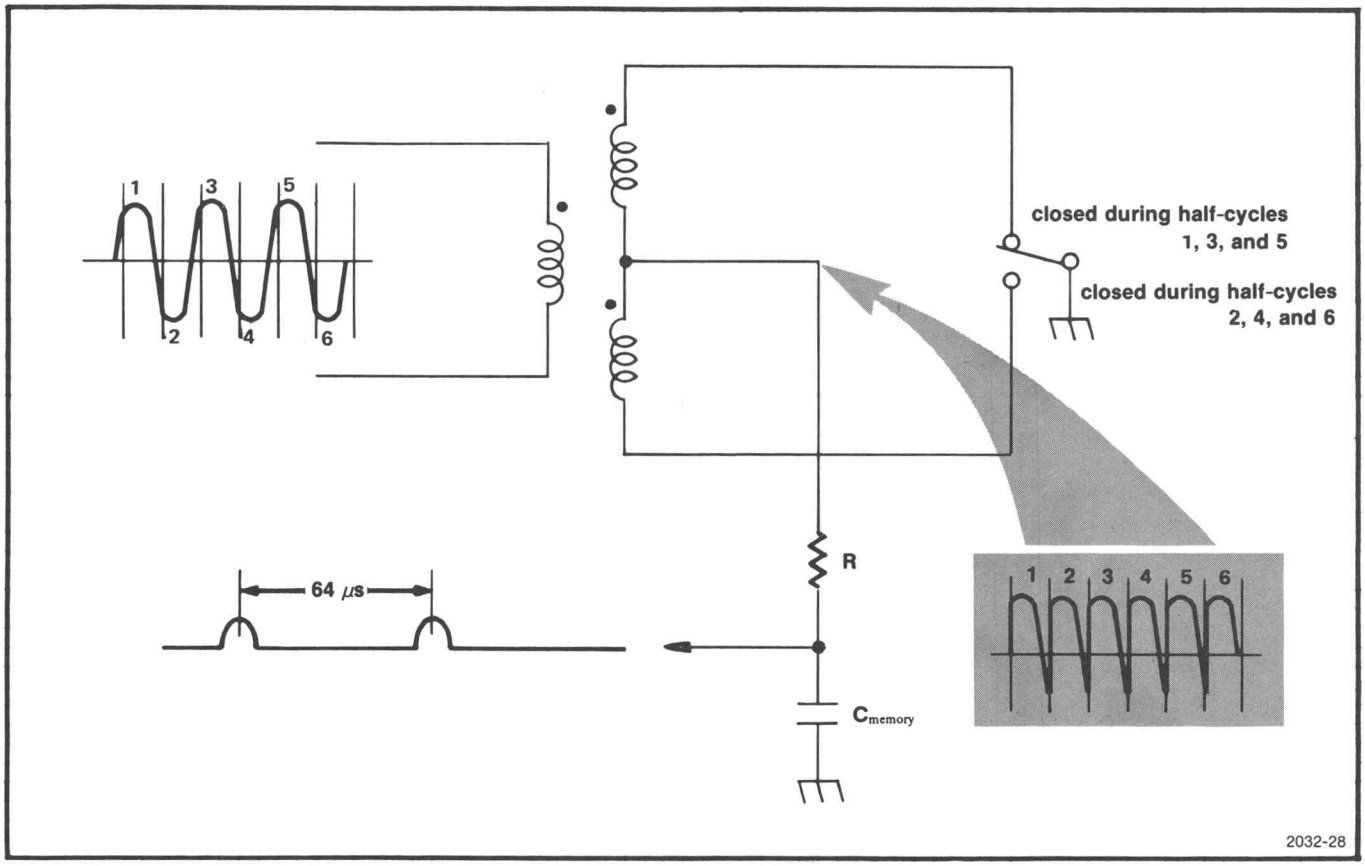

Fig. 4-3. Simplified diagram of NTSC Phase Detector operation.

The band switch is a non-inverting operational amplifier, (U1540A) with the negative input biased slightly positive. If the error signal across C1564 exceeds the fixed bias at U1540A pin 2, the output (pin 1) becomes 24 V peak-to-peak square waves at the error signal rate. The square waves are positive-peak detected by CR1552 and averaged by C1553, saturating Q1543. With Q1543 saturated, the input resistance to U1548 is R1553 in parallel with R1551, increasing the gain of U1548 and increasing the rate at which the bias on the Subcarrier Oscillator varicap changes. This allows rapid lock of the Subcarrier Oscillator to the burst. Once lock is accomplished, the output of U1540A goes negative, turning off Q1543, switching the band switch to narrow band. The narrow band state of the band switch makes the Error Amplifier immune to noise.

U1548 is an inverting operational amplifier, slew-rate limited by C1555 and R1555 in the feedback loop.

U1548's positive input is referenced to a variable resistive divider, allowing R1561 (Balanace) to set the level at U1548 pin 3 from 0 V to +0.15 V. The Balance control is adjusted for minimum phase shift should burst amplitude vary.

Pin 1 of P1699 goes to −15 V when the front-panel PUSH (TEST CIRCLE) button is pressed. The Error Amplifier output is then about −12 V, reducing the bias on the Subcarrier Oscillator varicap, and raising the oscillator frequency by 100 Hz (adjustable by R1652).

The Error Amplifier output is taken from U1548 pin 6, and applied to the Subcarrier Oscillator.

Subcarrier Oscillator

Y1670 and Q1680 form a crystal-controlled oscillator, operating about class A, with the fine tuning of the oscillator frequency done by varicap CR1663. Oscillation is sustained by the negative-resistance characteristic of the emitter-to-base junction of Q1680, in conjunction with the parallel combination of the reactances of C1685 and C1690. (See Fig. 4-5.) As long as this negative-resistance characteristic is adequate to overcome losses in the bulk resistance of the crystal, oscillations can continue. The negative resistance can be adjusted by selecting the proper emitter resistor for Q1680. The ratio of C1690 to C1685 is important in providing adequate signal current out of the oscillator. The ratio of crystal current to signal current is roughly equivalent to the ratio of C1685 to C1690.

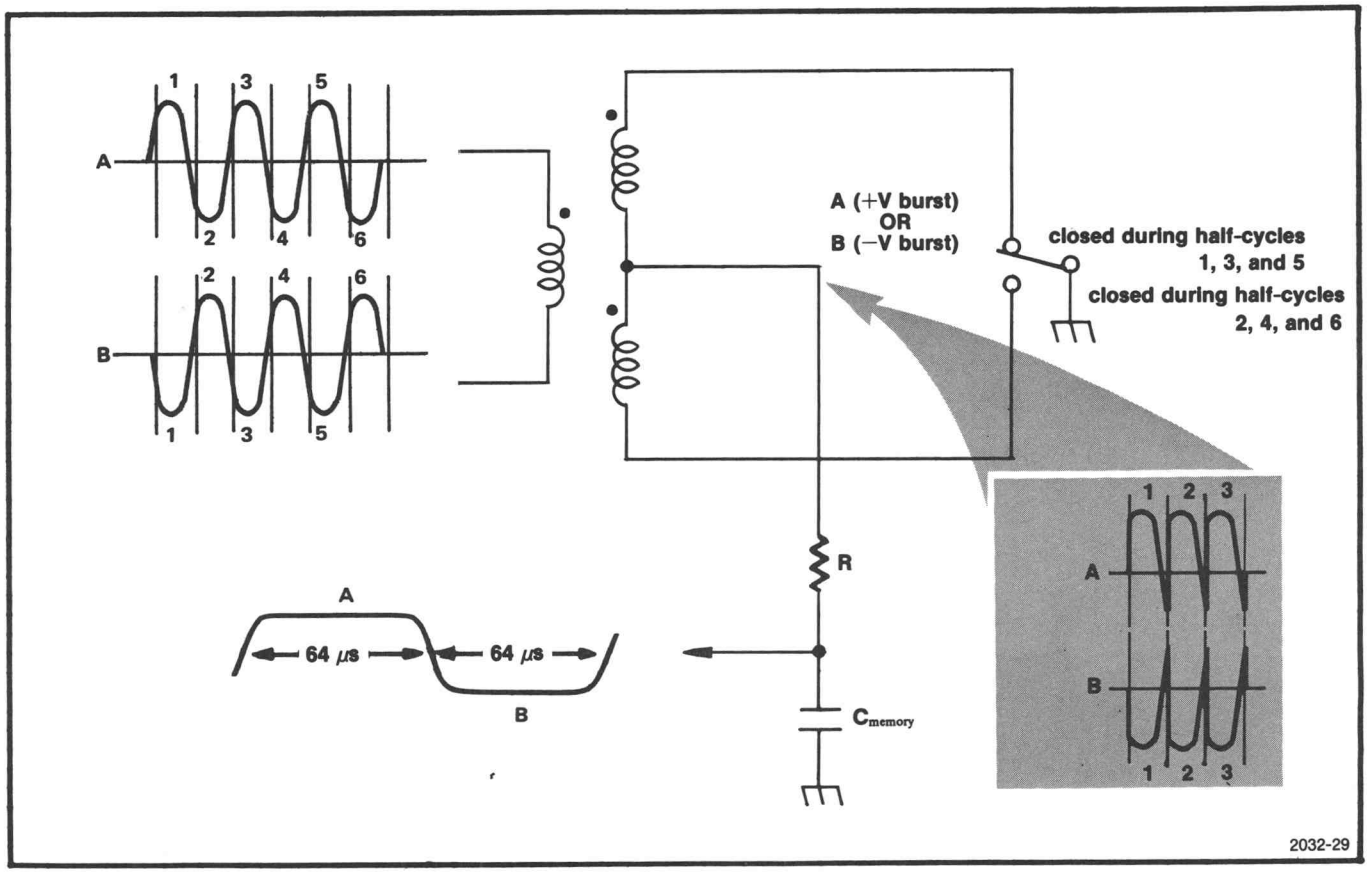

Fig. 4-4. Simplified diagram of PAL Phase Detector operation.

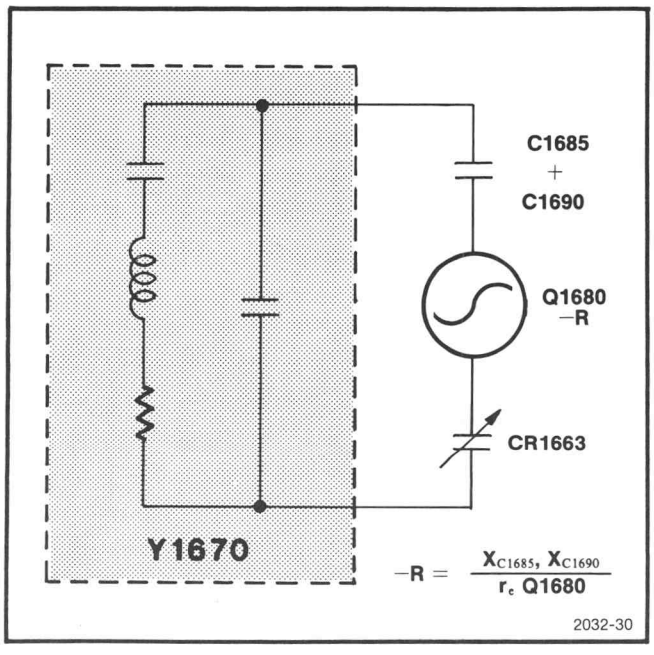

Fig. 4-5. Equivalent Subcarrier Oscillator circuit.

R1554 and R1652 limit the range of frequency control of CR1663. R1554 is adjusted for 100 Hz below subcarrier frequency and R1652 is adjusted for 100 Hz above subcarrier frequency.

Q1680's collector load is the front-panel PHASE control. The output of the PHASE control drives amplifier Q1782, which provides subcarrier signal to the B-Y (U) and R-Y (V) Demodulators on Diagram 3. The output of Q1782 also drives peak detector CR1671 which supplies bias to agc amplifier Q1781. The conduction of Q1781 varies the bias on oscillator transistor Q1680 to maintain a nearly constant amplitude at the output of the PHASE control.

The subcarrier signal from Q1680 is also applied to the Phase Detector circuit, through emitter follower Q1579.

When the ϕ REF switch (1420) or EXT SUB switch (1421, 1422) is set to EXT, Q1781 is turned off, disabling the internal Subcarrier Oscillator. Continuous External

Subcarrier from the Ext Sub Input Amplifier is coupled through the front-panel PHASE control (goniometer) in the external mode.

+5 V Supply

VR1986 sets the base of Q1995 at +5.6 V, resulting in a regulated +5 V at the emitter. This voltage is filtered by C1888 and applied to the points in the circuit requiring +5 V.

DIAGRAM 3

DEMODULATOR AND DEFLECTION AMPLIFIER

Circuits on this Diagram accept chrominance signals from the Gain Cell on Diagram 1, demodulate them with reference to the internally-regenerated subcarrier or External Subcarrier, and apply the resultant signals to the Deflection Amplifier.

180° Phase Switcher

U1614 drives two clamps, one on each of the opposite-polarity carrier inputs of the R-Y (V) Demodulator to cause demodulation to alternate 180° on successive lines. Switching takes place only if the front-panel PUSH (TEST CIRCLE) button is pressed or if the front-panel ϕ REF switch is in the NTSC position on the 1421 and 1422. In the ϕ REF PAL position, with the PUSH (TEST CIRCLE) switch (S225B) closed (normal position), the preset input of U1614 is at ground, causing pin 5 (1 output) to be high. With U1614 pin 5 high, Q1605 is saturated and U1715 pin 7 (+ carrier input) is driven by the reference subcarrier.

With the PUSH (TEST CIRCLE) switch open or the ϕ REF switch on the 1421 and 1422 in the NTSC position, U1614 is clocked at a line rate by positive-going pulses from the collector of Q1528. Q1528 is driven by a negative-going pulse from the H Regenerator circuit on Diagram 2. The leading edge of this pulse is coincident with the leading edge of line sync. During the positive interval, Q1528 is saturated. After the negative transition, it takes about 1 μs for Q1528 to turn off.

PAL Preset (1421, 1422)

Placing the ϕ REF switch in NTSC positions allows either the PAL Preset circuit or the EXT PAL Pulse Amplifier circuit to drive U1614's preset input. The PAL Preset output is derived from the Phase Detector circuit, and ensures that the + carrier input of the V Demodulator is driven by the reference subcarrier on +V lines.

The base of Q1531 is driven by the Phase Detector error signal from U1540B pin 7. Q1531's emitter time constant consists of C1532 combined with R_{tr} of the transistor. With approximately 3 mA emitter current, the R_{tr} is about 8 Ω. The time constant is about 1.8 μs, so Q1531's collector signal is 9 μs pulses. The pulses alternate in polarity with each line. Q1513 inverts and amplifies the positive-going signals at its base.

The collector of Q1513 drives U1614 pin 4, the preset input, with negative-going pulses at about burst time on +V lines. This ensures that U1614 pin 5 will be positive and Q1605 saturated on +V lines and the V Demodulator + carrier input (pin 7) will be driven by the reference subcarrier.

When the EXT SUB switch is in the EXT position, the PAL Preset pulses from Q1513 are disconnected from the preset input of U1614. The EXT PAL Pulse Amplifier on Diagram 5 now drives the preset input of U1614 with a negative pulse. The pulses occur at the leading edge of sync for the −V lines, causing pin 5 of U1614 to be positive at this time. Shortly after the pulse has occurred, U1614 is clocked, changing pin 5 to be negative during the −V line and positive during the +V line. This ensures that the + carrier input of the V Demodulator will be driven by the reference subcarrier during the +V lines.

R-Y (V) Demodulator

The reference subcarrier from Diagram 2 is applied to 90° phase-shift network C1646-L1666-C1653 and from there, past the 180° Phase Switcher, clamps to the + and − carrier inputs of the R-Y (V) Demodulator (U1715 pin7 and pin 8).

The − signal input (pin 4) is driven by input signal chrominance from the Demodulator Driver on Diagram 1.

The output (pin 6) is a series of levels, with amplitudes corresponding to the phase difference between the reference subcarrier and signal chrominance. The R-Y (V) Demodulator reference subcarrier is phased on the R-Y (V) axis. The demodulated chrominance passes through a low-pass filter that removes any remaining subcarrier and determines rise time and delay to the R-Y (V) Deflection Amplifier Driver.

B-Y (U) Demodulator

U1755 receives reference subcarrier at its + carrier input (pin 7) and input signal chrominance at the − signal input (pin 4).

The reference subcarrier at U1755 has not been phase shifted, so it is phased on the B-Y (U) axis. The output at pin 6 is a series of levels with amplitudes corresponding to the phase relationship of input signal chrominance to B-Y (U) reference subcarrier.

This output signal is filtered as in the R-Y (V) Demodulator and applied to the B-Y (U) Deflection Amplifier Driver.

Sync Tip Clamp

Q1739 is driven to saturation during line-sync time by a pulse from the Sync Tip Clamp Generator on Diagram 2. During the time Q1739 is saturated, any residual subcarrier present in the signal is grounded, providing a clean zero carrier reference for the demodulator circuits. When the demodulator outputs go to zero, so do the deflection amplifiers. This provides an accurate center dot on the display.

R-Y (V) Deflection Amplifier Driver

Q1927, Q1928, and Q1929 form an inverting operational amplifier with a voltage gain of about fifteen (R1912/R1920). The output of the amplifier is taken from the emitter of Q1929, and drives the R-Y (V) Deflection Amplifier.

R1837 routes a small amount of R-Y (V) signal current to the input of the B-Y (U) Deflection Amplifier Driver circuit. This current would rotate the display slightly but adjustable signal current of opposite phase is applied from R1916 (V Align). The amount of rotation then becomes adjustable providing a form of geometry control.

B-Y (U) Deflection Amplifier Driver

Q1933, Q1935, and Q1937 form the B-Y (U) Deflection Amplifier Driver. This circuit is similar in operation to the R-Y (V) Deflection Amplifier Driver.

R1839 routes B-Y (U) signal current to the input of the R-Y (V) Deflection Amplifier Driver and R1951 becomes a form of orthogonality control.

R-Y (V) Clamp

U1915 is an operational transconductance amplifier used as a "sample and hold" device. Demodulated signal chrominance drives the negative input (pin 2), while offset voltage is applied to the positive input (pin 3) from the front-panel VERT position control. During the center of line sync time, a 2.4 μs pulse is applied to the amplifier bias input (pin 5), turning the device on. The level at pin 2 is transferred to the storage capacitor, C1910, during the 2.4 μs "on" time.

The stored level is applied through source follower Q1811 to the bias input (pin 5) of U1715, changing the output bias current from U1715, and changing the R-Y (V) Deflection Amplifier Driver output dc level.

B-Y (U) Clamp

U1950 is the sample and hold device, driving memory capacitor C1951, and Q1855. In operation, this circuit is identical to the R-Y (V) Clamp.

R-Y (V) Deflection Amplifier

Q2700 and Q2735 form a paraphase amplifier that accepts the single-ended output from the R-Y (V) Deflection Amplifier Driver and produces the double-ended output required to drive the vertical deflection plates.

B-Y (U) Deflection Amplifier

Q2775 and Q2795 form the B-Y (U) Deflection Amplifier. In operation, it is similar to the R-Y (V) Deflection Amplifier. C2890, C2891, and R2780 provide high-frequency peaking.

DIAGRAM ◈4◈
POWER SUPPLY & CRT

Circuits on this diagram provide operation potentials for the instrument, including accelerating potential for the crt.

Power Input

The Mains voltage is applied to the primary of T430 through a choice of two plug-in jumpers that can be selected for 110 Vac, 220 Vac and for low, medium and high Mains voltage ranges. (See Installation, Section 3.)

T430 has two secondaries; one for the +15 V and −15 V supplies, and one for the +210 V supply.

+15 V Supply

Q3018, Q3019, VR3020, and Q425 form the +15 V Supply. Q3018 is a constant-current load, demanding 2 mA from the circuit. If the current load on the circuit increases, the voltage at the base of Q3019 decreases. The

constant current demanded by Q3018 is then satisfied through the base of Q425, decreasing its emitter-to-collector voltage drop and bringing the supply back to +15 V.

VR3020 is the supply reference voltage for this circuit.

−15 V Supply

Q3080, Q3088 and Q427 form the −15 V Supply. In operation, this circuit is similar to the +15 V Supply.

+210 V Supply

Q3905 and Q428 form the +210 V Supply. The output voltage is established by the constant current in R3910 driving R3915. If the current load on the circuit increases, base current in Q3905 increases, causing the emitter of Q428 to move in the positive direction, bringing the supply back to its proper level.

High Voltage

Q430 is the High Voltage Oscillator; Q3279 and Q3380 form a regulator for the supply.

Q430 oscillates at approximately 30 kHz. The principal frequency-determining components are C3350 and the inductance of the transformer.

When power is first applied, the base of Q3279 sees only the −15 V and turns on. Collector current for Q3279 saturates Q3380, providing base current for Q430 and turning Q430 on. Regenerative feedback is accomplished by inductive coupling from the collector winding to the base winding of T3510.

As the amplitude of the oscillation increases, the lower secondary winding of T3510 begins to supply positive voltage for the resistor divider on the base of Q3279. As this voltage rises toward +200 V, the current through Q3279 decreases, bringing Q3380 out of saturation. Q3380 biases Q430 so that the amplitude of oscillation is stable.

R3210 samples the dc current in the high voltage secondary of T3510 and causes the regulator to change the oscillator amplitude to maintain constant current at the crt cathode.

The output of the high voltage rectifier goes to a resistor divider that divides the voltage down for the FOCUS, INTENSITY, and Intensity Limit controls (R420, R410, and R3769 respectively).

VR3760 maintains a constant voltage across the INTENSITY control as the INTENSITY control is varied.

The third secondary winding in T3510 is the 6.3 V heater winding for the crt.

DIAGRAM 5

EXT SUB AND PAL PULSE INPUT AMPLIFIERS

External Subcarrier Amplifiers

The external subcarrier reference signal is picked off the EXT SUB REFERENCE INPUT loop-through and drives the series-resonant peaking circuit, L1204 and C1205. The output of the series-resonant circuit is ac coupled, via C1206, to a grounded-base transistor, Q1215. Q1215 drives the base of an inverter, Q1235, which then drives the front-panel goniometer. Q1205, the circuit enable, is off as a result of removing the −15 V from its base. This forward-bias voltage is removed by setting the ϕ REF switch (1420) or the EXT SUB switch (1421, 1422) to EXT.

When the ϕ REF switch (1420) or EXT SUB switch (1421, 1422) is set to EXT, Q1781 (Demodulator board) is turned off, disabling the internal Subcarrier Oscillator.

Subcarrier amplitude is sampled at the collector of Q1782 and is fed (via P1799-2 to P1210-5 on the Ext Subcarrier board) to the Peak Detector, CR1233 and C1233 (Ext Subcarrier board). This forms an agc signal to drive an inverting amplifier (U1235). U1235 controls emitter follower Q1225, which acts as a current source to control the amplitude of external subcarrier that is applied to the demodulators as the External Subcarrier input changes amplitude.

The INPUT switch (S245) will determine if the internally-generated clamping pulse (generated by the H Regenerator) is referenced to the A INPUT channel when the INPUT switch is set to A, or the B INPUT channel when the INPUT switch is set to B. With the INPUT switch set to SUBCARRIER A, the clamp pulse times are determined by the H Regenerator, which is free-running in this mode.

PAL Pulse Amplifiers (1421, 1422)

The external PAL Pulse is ac-coupled (via C1202) from the loop-through input to a grounded-base transistor (Q1209), which drives a pulse-shaping circuit (C1214 and R1219). This signal then drives the base of Q1223, which acts as an inverter to drive differentiator C1223 and R1129.

This differentiated signal then drives two more inverters (Q1234 and Q1249) to provide a 5 V negative-going pulse to the preset input of U1614, the 180° Phase Switcher. This keeps U1614 set correctly for the NTSC displays.

Q1202, the circuit enable, is off as a result of applying −15 V to its base. The −15 V is applied to the base when the EXT SUB switch is set to EXT and the ϕ REF switch is in the NTSC positions.

CALIBRATION

Introduction

This section provides information necessary to; (1) verify that this instrument meets the electrical specification in Section 1, (2) verify that all controls function properly, and (3) perform all internal adjustments. This section is divided into two subsections, Performance Check and Adjustment Procedure.

Procedures. The Performance Check provides a check of the instrument performance in reference to the electrical specification listed in Section 1. The steps of the check are organized to reduce the number of setup changes. No internal adjustments are to be made during the Performance Check. If the instrument does not meet the performance requirements given in the procedure, refer to the Adjustment Procedure.

A short-form of the Performance Check is provided for those who are familiar with the instrument and how the checks are to be performed.

The Adjustment Procedure provides a complete sequential adjustment of the internal controls.

The vectorscope front- and rear-panel names in the text are capitalized; e.g., INPUT. Control and connector names on test equipment and internal controls in the Vectorscope have only the first letter capitalized; e.g., Time/Div. When a generic term is used, the names will not be capitalized; e.g., test oscilloscope, video generator.

Test Equipment. The capabilities of the test equipment listed are the minimum required to calibrate the Vectorscope. If alternative equipment is used, it must meet or exceed the specifications of the listed equipment.

Refer to Table 5-1 for the test equipment required for performance checks and adjustment.

Table 5-1

TEST EQUIPMENT REQUIRED

Description	Minimum Specification	Where Used	Equipment Used
Oscilloscope Mainframe	Bandwidth, dc to at least 30 MHz.	Performance Check and Adjustment Procedure.	TEKTRONIX 7603.
Oscilloscope Dual-Trace Vertical Amplifier Plug-in	Deflection Factor at least 5 mV/div.	Performance Check and Adjustment Procedure.	TEKTRONIX 7A18.
Oscilloscope Vertical Amplifier and Differential Comparator Plug-in	Deflection Factor at least 1 mV/div.	Performance Check and Adjustment Procedure	TEKTRONIX 7A13.
Oscilloscope Time Base Plug-in	Sweep range, 5 μs to 2 ms/div. Delayed sweep.	Performance Check and Adjustment Procedure	TEKTRONIX 7B53A
Power Supply Module	Capable of driving several loads	Performance Check and Adjustment Procedure	TEKTRONIX TM 503
Precision dc voltmeter (with leads)	Measurement range, 500 V; accuracy, within 0.1%.	Performance Check and Adjustment Procedure	TEKTRONIX DM 502 (operates in TM 500-Series power module).

Table 5-1 (cont)

TEST EQUIPMENT REQUIRED

Description	Minimum Specification	Where Used	Equipment Used
Sine-wave Generator	Frequency Range, 50 kHz to 5 MHz. Output variable, less than 1 V to greater than 2 V.	Performance Check and Adjustment Procedure	TEKTRONIX FG 502 (operates in TM 500-Series power module).
Frequency Counter	Accurate within 1 part in 10,000,000; resolution to 0.1 Hz.	Performance Check and Adjustment Procedure	TEKTRONIX DC 502 (operates in TM 500-Series power module).
Video Signal Generator	Accurate Color Bar and Modulated Staircase test signals.	Performance Check and Adjustment Procedure	1420—TEKTRONIX 1410 1421—TEKTRONIX 1411 1422—TEKTRONIX 145-M
Return Loss Bridge	Frequency range, 50 kHz to 5 MHz. Termination resistance 75 Ω ±2%.	Performance Check	Tektronix Part No. 015-0149-00 Return Loss Bridge.
75 Ω cables (4 required)	Impedance, 75 Ω Type, RG-59/U Length, 42 inches Connectors, bnc.	Performance Check and Adjustment Procedure	Tektronix Part No. 012-0074-00
50 Ω cable (1 required)	Impedance, 50 Ω Type, RG-58/U Length, 42 inches Connectors, bnc.	Performance Check and Adjustment Procedure	Tektronix Part No. 012-0057-01
50 Ω cable (1 required)	Impedance, 50 Ω Type, RG-58/U Length, 20 inches Connectors, bnc.	Performance Check and Adjustment Procedure	Tektronix Part No. 012-0076-00
75 Ω end-line termination (1 required)	75 Ω within 0.5%. Connectors, bnc.	Performance Check and Adjustment Procedure	Tektronix Part No. 011-0102-00
75 Ω feed-through termination (3 required)	75 Ω within 0.2%. Connectors, bnc.	Performance Check and Adjustment Procedure	Tektronix Part No. 011-0103-02
Minimum loss attenuator. (1 required)	Impedance, 50 to 75 Ω; Power 1/2 watt; Connectors, bnc.	Performance Check and Adjustment Procedure	Tektronix Part No. 011-0057-00
Bnc Cable-T Connector	Connectors, bnc.	Performance Check and Adjustment Procedure	Tektronix Part No. 067-0525-00
Bnc-T Connector	Connectors, bnc.	Performance Check and Adjustment Procedure	Tektronix Part No. 103-0030-01
10X Probe	Compatible with the oscilloscope being used.	Used throughout the Performance Check and the Adjustment Procedures	Tektronix Part No. 010-6053-13

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Table 5-1 (cont)

TEST EQUIPMENT REQUIRED

Description	Minimum Specification	Where Used	Equipment Used
1X Probe	Compatible with the oscilloscope being used.	Used throughout the Performance Check and the Adjustment Procedures	Tektronix Part No. 010-6101-01
Screwdriver	3-inch shaft, 3/32-inch bit	Used only in the Adjustment Procedure	Xcelite R3323
Low-capacitance screwdriver	1 1/2-inch shaft	Used only in the Adjustment Procedure	Tektronix Part No. 003-0000-00
Coil alignment tool	3-inch shaft	Used only in the Adjustment Procedure	Tektronix Part No. 003-0497-00

SHORT-FORM PERFORMANCE CHECK

1. Check Intensity Limit Page 5-5

No amplitude change as intensity is varied.

2. Check Astigmatism Page 5-5

Origin should be a round spot.

3. Check Power Supply Ripple Page 5-5

−15 V, 10 mV; +15 V, 10 mV; +210 V 1 V.

4. Check Gain Match Page 5-6

Between Channels A and B.

5. Check Vector Phase Accuracy Page 5-6

Within 1° of graticule markings.

6. Check B-Y (U) and R-Y (V) Alignment Page 5-6

Color Dots should fall within 1° of the B-Y (U) axis and within 1° of the R-Y (V) axis.

7. Check Filters Page 5-6

For good response.

8. Check Deflection Amplifier Match Page 5-7

Overlay of display.

9. Check Oscillator Range Page 5-7

F_{sc} ±100 Hz.

10A. Check DC Balance (1420) Page 5-8

Straight line at crossover point between fields.

10B. Check DC Balance (1421, 1422) Page 5-8

At crossover point between fields, the resultant of the sync pulses is 0 V dc.

11. Check Phase Shift Page 5-8

0.5° or less as INPUT switch is changed between channels; 0.5° or less as ϕ REF switch is changed between A and B; 1.0° or less as GAIN control is varied; 0.5° or less as INPUT switch is changed between A and SUB (A INPUT).

12. Check GAIN Range Page 5-8

140 mV chrominance vector should vary from 1/2 amplitude to at least graticule edge.

13. Check Differential Gain Page 5-9

Tilt should not exceed 1%.

14. Check Differential Phase Page 5-10

Tilt should not exceed 2%.

15. Check burst Jitter Page 5-10

Burst jitter should not exceed 0.5°.

16. Check Ext PAL Pulse Operation (1421 and 1422 only) Page 5-11

For proper −V and +V burst vectors overlay as the PAL pulse is varied from 1 V to 8 V p-p.

17. Check Ext Subcarrier Drive Page 5-12

0.8 V of external subcarrier at TP1775 as Ext Sub Input signal is varied between 1 V and 4 V p-p.

18. Check Quadrature Phase Page 5-12

Test circles should be overlayed.

19. Check Position Control Range Page 5-12

VERT POS and HORIZ POS controls should move the display origin ±1/4 inch each side of graticule center.

20 Check Clamp Stability Page 5-12

Origin should not move more than 1/64 inch as the PHASE control is varied.

21. Check Phase Shift versus Burst Amplitude Page 5-12

2° or less phase shift as burst is varied ±6 dB.

22. Check Gain Page 5-13

Display amplitude should be within 1% of the graticule edge.

23. Check Chrominance Bandwidth Page 5-13

−3 dB point of upper bandwidth:	1420—3.980 MHz to 4.180 MHz. 1421—4.833 MHz to 5.033 MHz. 1422—3.975 MHz to 4.176 MHz.
−3 dB point of lower bandwidth:	1420—2.979 MHz to 3.180 MHz. 1421—3.833 MHz to 4.033 MHz. 1422—2.975 MHz to 2.176 MHz.

24. Check Isolation Page 5-14

At least 80 dB down between Channels A and B at F_{sc}.

25. Check Return Loss Page 5-15

For Channels A and B, at least 46 dB down. For EXT SUB and EXT PAL PULSE inputs, at least 34 dB down.

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PERFORMANCE CHECK

NOTE

Test points listed in Steps 1 through 3 are found on the Power Supply circuit board (A3). See Power Supply Adjustment Locations pullout in Section 9.

Setup conditions for Steps 1 through 3 are illustrated in Fig. 5-1.

VECTORSCOPE PRELIMINARY CONTROL SETTINGS:

POWER	On
SCALE ILLUM	Visible scale display
INTEN	Visible display
FOCUS	Well-defined display
VERT POS	Center the origin on horizontal center line
HORIZ POS	Center the origin on vertical center line
GAIN	Cal position

1. Check Intensity Limit

a. Rotate the INTEN control until the display is just visible.

b. Rotate the PHASE control until the chrominance vectors fall in their proper boxes.

c. Rotate the INTEN control for maximum intensity.

d. CHECK—that the display amplitude does not change.

e. Rotate the INTEN control until the display is just visible.

2. Check Astigmatism

a. Rotate HORIZ POS to set the display origin in a clear place in the graticule. Set FOCUS fully clockwise.

b. CHECK—that the display origin is a round spot (not elongated in any direction).

c. Rotate the FOCUS control for a well-defined display.

3. Check Power Supply Ripple

a. CHECK—power supply ripple as follows:

1X Probe From Test Oscilloscope to	Supply	Maximum Ripple
TP3285	−15 V	10 mV
TP3112	+15 V	10 mV
TP3812	+210 V	1 V

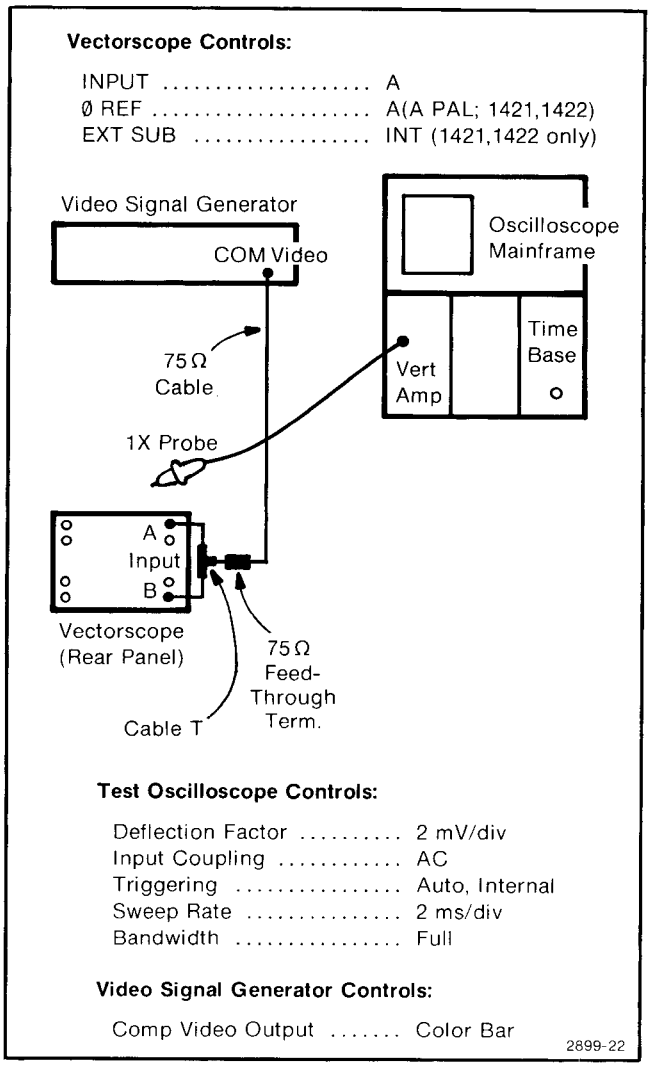

Fig. 5-1. Setup conditions for Steps 1—3.

NOTE

Test points listed in Steps 4 through 15 are found on the Demodulator circuit board (A1). See Demodulator Adjustment Locations pullout in Section 9.

Setup conditions for Steps 4 through 11 are illustrated in Fig. 5-2.

4. Check Gain Match

a. Rotate the PHASE control until all chrominance portions of the display are at their proper graticule marks. Set the GAIN control to the CAL position.

b. Set the INPUT switch to B.

c. CHECK—that the Channel B display is the same amplitude as the Channel A display.

5. Check Vector Phase Accuracy

a. Set the GAIN control to the CAL position. Rotate the PHASE control until the chrominance portions of the display are at their proper graticule marks.

b. CHECK—that all color vector dots are within 1° of their proper phase marks.

6. Check B-Y (U) and R-Y (V) Alignment

a. Set the ϕ REF switch to B (B VECTOR NTSC; 1421, 1422).

b. Set the video generator Color Bar B-Y (U) switch off.

c. Press the PUSH (TEST CIRCLE) button about halfway in.

d. Rotate the PHASE control for best overlay of color dots.

e. CHECK—that all color dots fall within 1° of the R-Y (V) axis graticule line.

f. Set the video generator Color Bar B-Y (U) switch on, and Color Bar R-Y (V) switch off.

g. CHECK—that all color dots fall within 1° of the B-Y (U) axis graticule line.

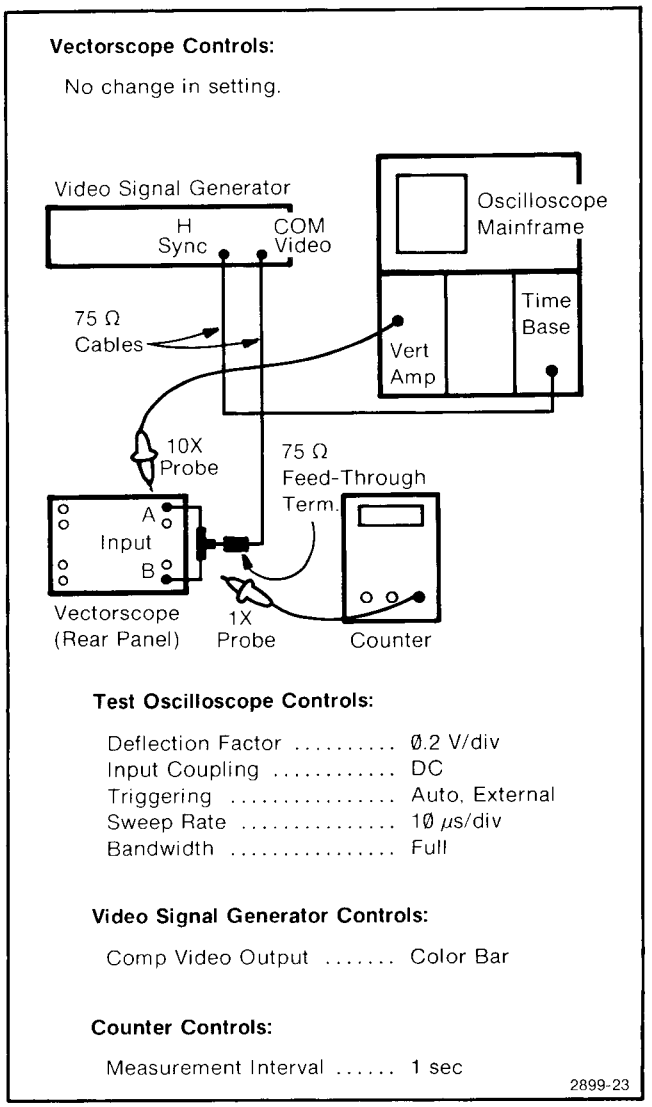

Fig. 5-2. Setup conditions for Steps 4—11.

h. Set the video generator Color Bar R-Y (V) switch on.

7. Check Filters

a. Connect the 10X probe from the test oscilloscope to TP1919.

b. CHECK—that the demodulated R-Y (V) chrominance is free from rolloff, peaking, and ringing. See Fig. 5-3.

c. Move the 10X probe to TP1954.

d. CHECK—that the demodulated B-Y (U) chrominance is free from rolloff, peaking, and ringing. See Fig. 5-4.

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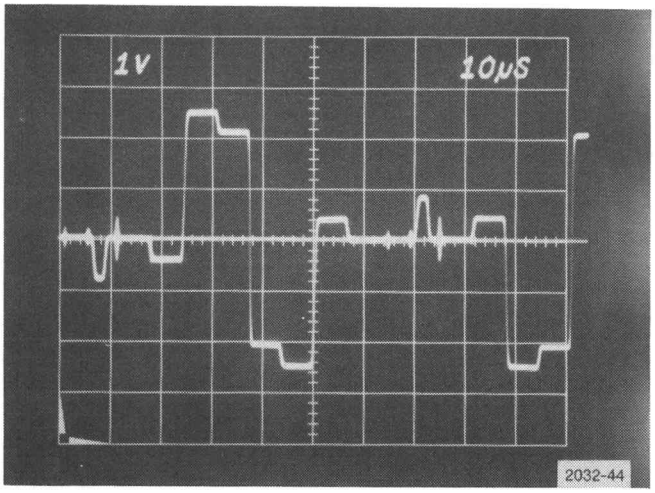


Fig. 5-3. Typical waveform at TP1919.

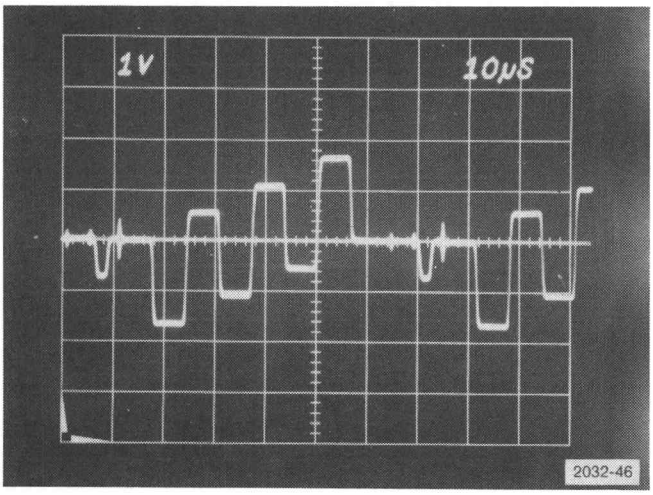


Fig. 5-4. Typical waveform at TP1954.

8. Check Deflection Amplifier Match

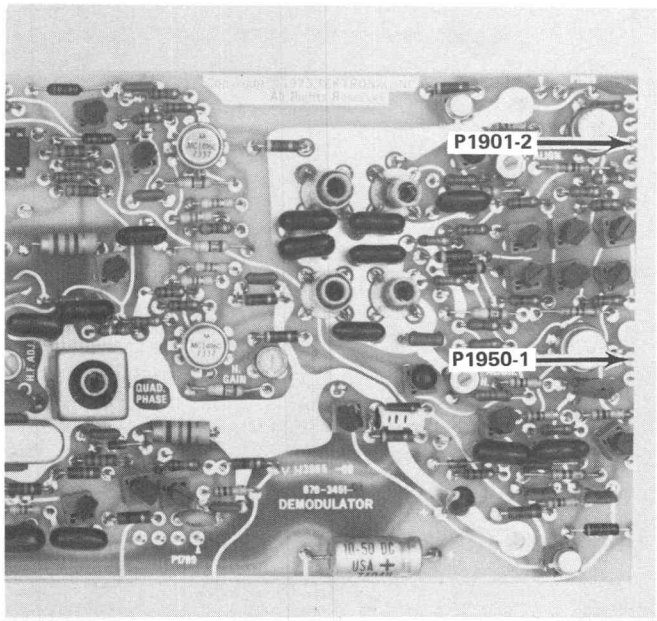
a. Remove the wire from P1950-1 and touch it to the wire in P1901-2. See Fig. 5-5. The Vectorscope display should be a line at a 45° angle.

b. CHECK—that the display is overlaid (no gap between lines).

c. Connect the wire removed in part a to P1950-1.

9. Check Oscillator Range

a. Connect the 1X probe from the digital counter to TP1775 on the Demodulator board. The digital counter will display the subcarrier frequency.



REMOVE THE WIRE FROM P1950-1 AND TOUCH IT TO P1901-2

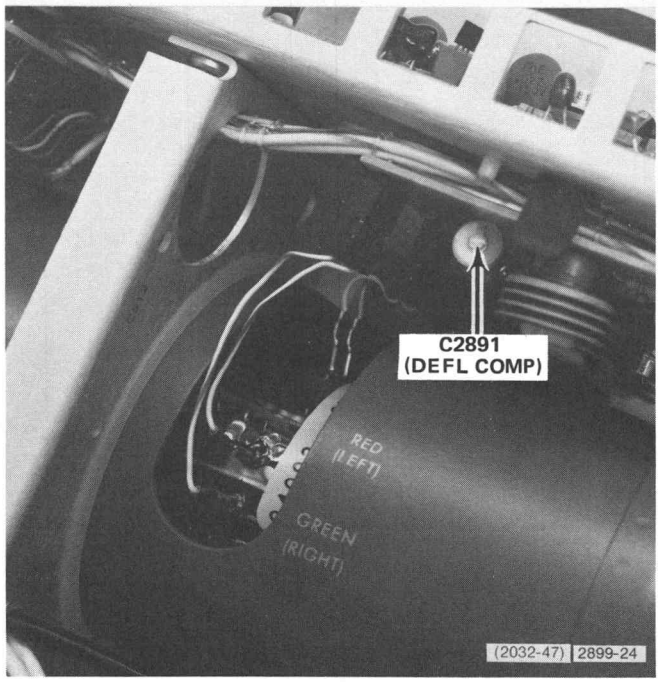


Fig. 5-5. Deflection compensation test points and control.

b. Connect a short piece of wire between P1699 and the + voltage pin.

c. CHECK—that the digital counter reads subcarrier frequency minus 100 Hz.

d. Move the short piece of wire to connect P1699 to the − voltage pin.

e. CHECK—that the digital counter reads subcarrier frequency plus 100 Hz.

10A. Check DC Balance (1420)

a. Connect the 10X probe from the test oscilloscope to TP1544.

b. CHECK—that the test oscilloscope display is an essentially straight line (see Fig. 5-6).

10B. Check DC Balance (1421, 1422)

a. Connect the 10X probe from the test oscilloscope to TP1544. (See Fig. 5-7.) Turn the video generator Bruch Sequence off.

b. CHECK—that the crossover point of two successive field sync pulses, time overlaid, is 0 V dc (see Fig. 5-7).

11. Check Phase Shift

a. Move the INPUT switch back and forth between A and B.

b. CHECK—that phase shift with INPUT switch change is 0.5° or less.

c. Move the ϕ REF switch back and forth between A and B.

d. CHECK—that phase shift with ϕ REF switch change is 0.5° or less.

e. Rotate the GAIN control to vary the display amplitude from minimum to the point at which the burst vector lies on the graticule edge.

f. CHECK—that phase shift with GAIN change is 1.0° or less.

g. Rotate the GAIN control to set the burst vector on the graticule edge.

h. Move the INPUT switch back and forth between A and SUBCARRIER (A INPUT).

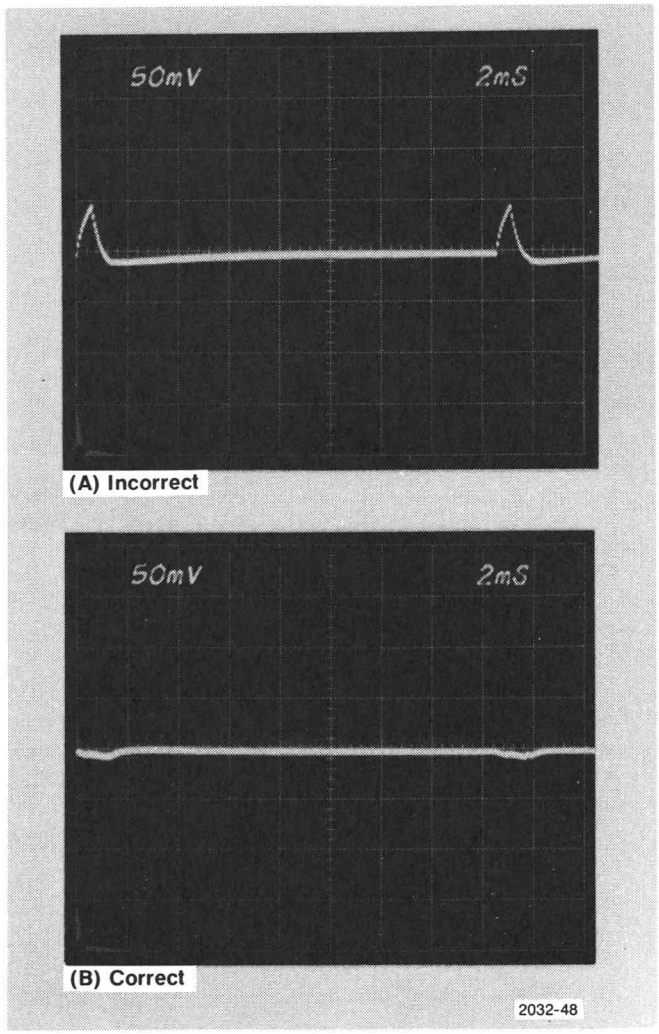


Fig. 5-6. 1420 — DC Balance adjustment.

i. CHECK—that phase shift is 0.5° or less.

NOTE

Setup conditions for Steps 12 through 17 are illustrated in Fig. 5-8.

12. Check GAIN Range

a. Set the video generator output for a staircase, modulated with 140 mV of subcarrier. Note the position of the 140 mV subcarrier vector on the Vectorscope graticule.

b. Rotate the GAIN control just out of detent to the minimum amplitude position.

c. CHECK—that the subcarrier vector is one-half the size, or less than, the vector noted in part a.

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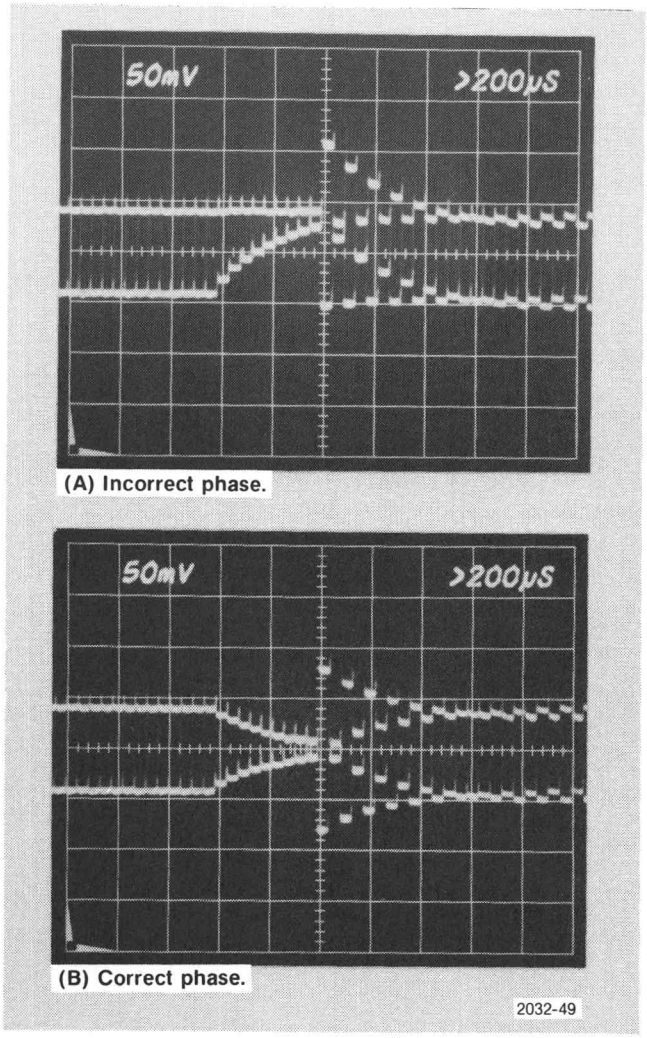

Fig. 5-7. 1421, 1422 — DC Balance adjustment.

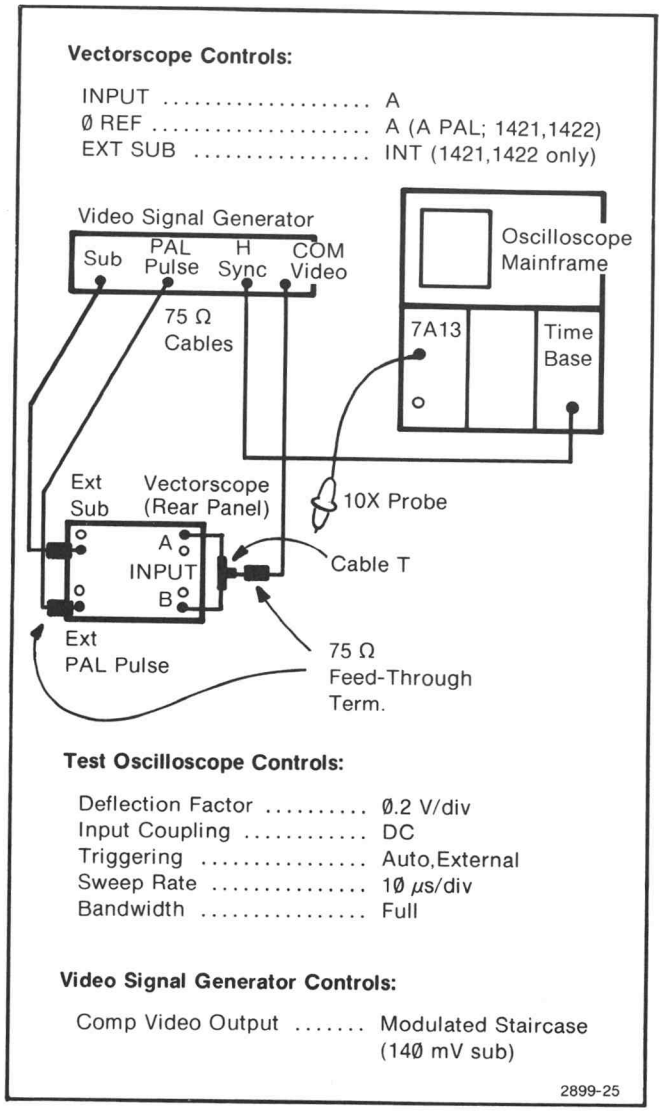

Fig. 5-8. Setup conditions for Steps 12—17.

d. Rotate the GAIN control fully clockwise.

e. CHECK—that the 140 mV subcarrier vector is at least at the graticule edge.

f. Set the GAIN control to CAL.

13. Check Differential Gain

a. Connect the 10X probe from the test oscilloscope Differential Comparator to TP1919 on the Demodulator board.

b. Set the video generator output for a staircase modulated with 140 mV of subcarrier.

c. Rotate the PHASE control for maximum amplitude of the demodulated subcarrier, as monitored on the test oscilloscope. See Fig. 5-9 or Fig. 5-10.

Observe the amplitude of the demodulated subcarrier signal.

d. Set the Differential Comparator Volts/Div to 1 mV and use the Comparison Voltage controls to view the top of the demodulated subcarrier.

e. CHECK—that tilt on the demodulated subcarrier signal does not exceed 1% of the amplitude noted in part c. See Fig. 5-11 or Fig. 5-12. (Tilt caused by changing luminance levels can be checked by switching staircase steps on and off.)

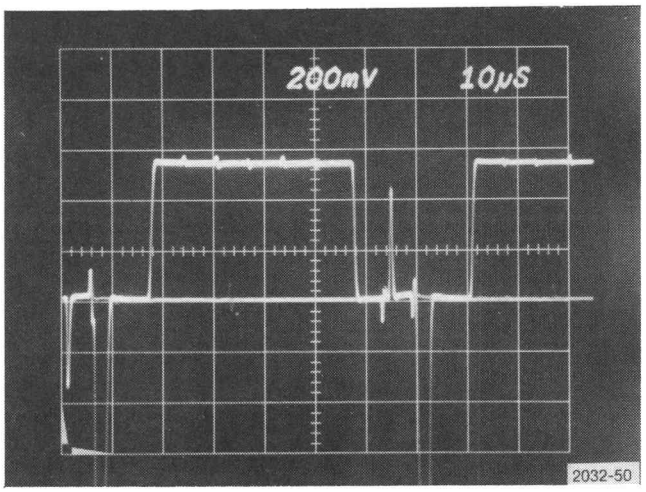

Fig. 5-9. 1420 — Differential Gain setup.

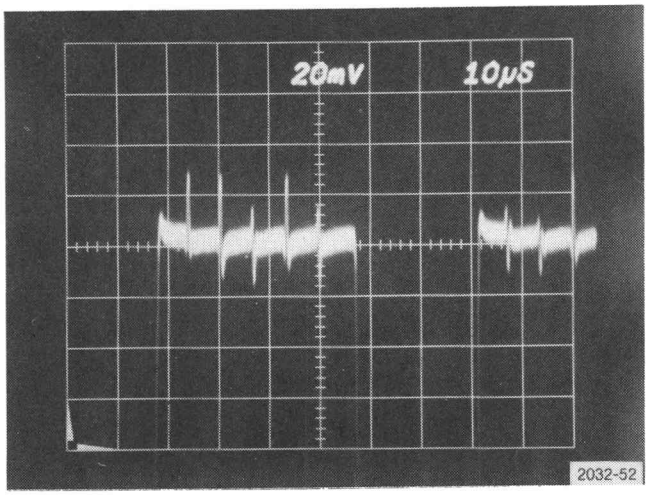

Fig. 5-11. 1420 — Differential Gain check.

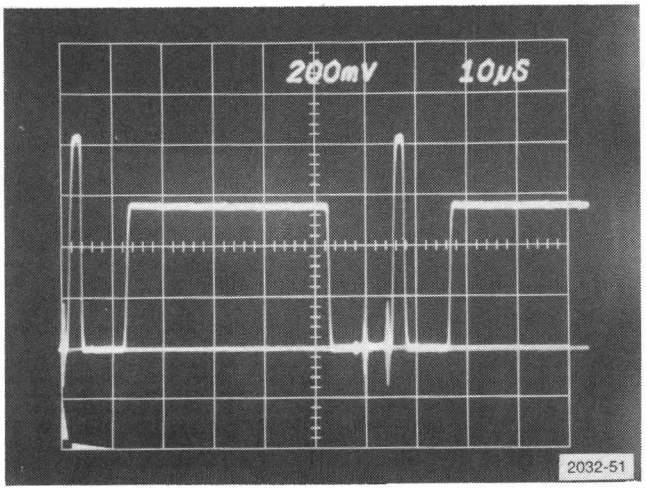

Fig. 5-10. 1421, 1422 — Differential Gain setup.

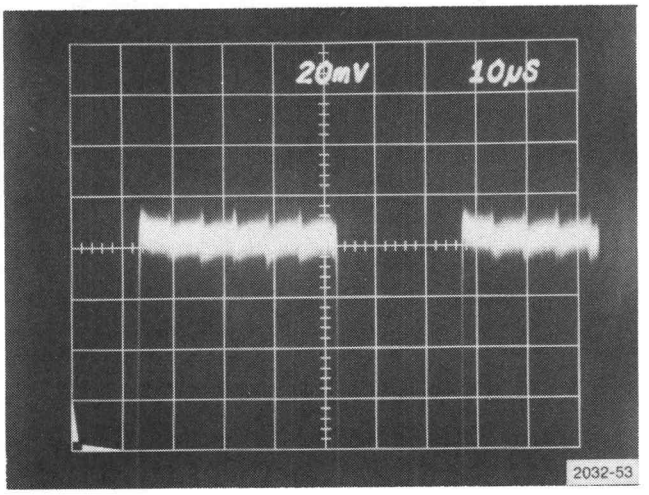

Fig. 5-12. 1421, 1422 — Differential Gain check.

14. Check Differential Phase

a. Set the Differential Comparator Comparison Voltage off.

b. Rotate the PHASE control for minimum amplitude of the demodulated subcarrier. See Fig. 5-13 or Fig. 5-14.

c. CHECK—that tilt caused by changing luminance levels does not exceed 2% of the amplitude noted in step 13c (2% is equal to 1° of differential phase). See Fig. 5-15 or Fig. 5-16.

d. Remove the 10X probe from the Vectorscope.

15. Check Burst Jitter

a. Set the INPUT switch to B and ϕ REF to B (B VECTOR PAL; 1421, 1422).

b. Set the GAIN control so the burst tips fall on the graticule edge.

c. CHECK—that the burst jitter does not exceed 0.5°.

NOTE

Test points listed in Steps 16 and 17 are found on the External Subcarrier board (A5). See Subcarrier Reference & Switching Adjustment Location pullout in Section 9.

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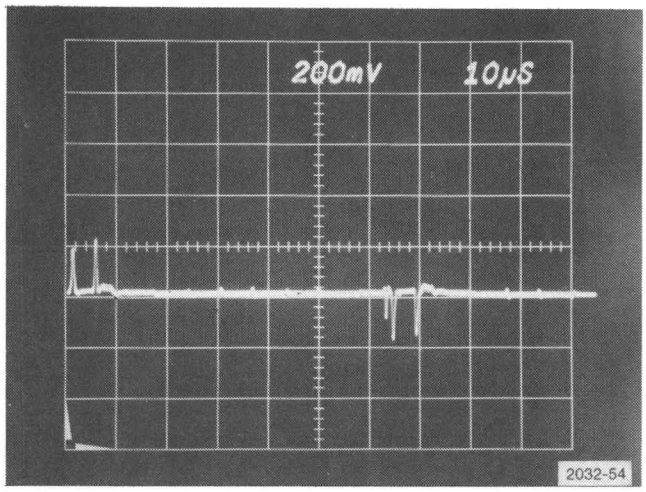

Fig. 5-13. 1420 — Differential Phase setup.

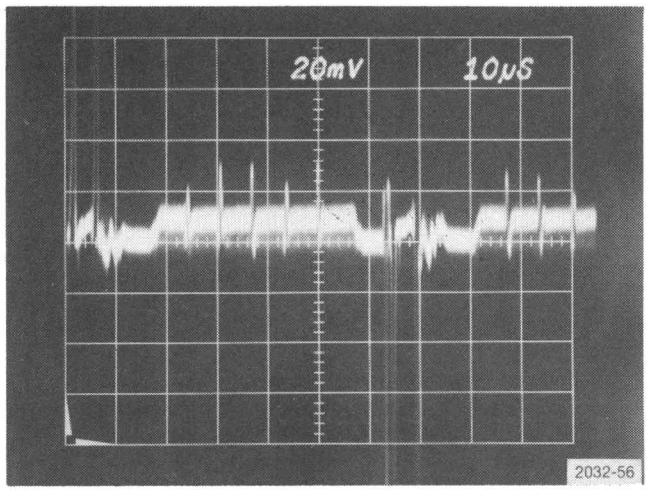

Fig. 5-15. 1420 — Differential Phase check.

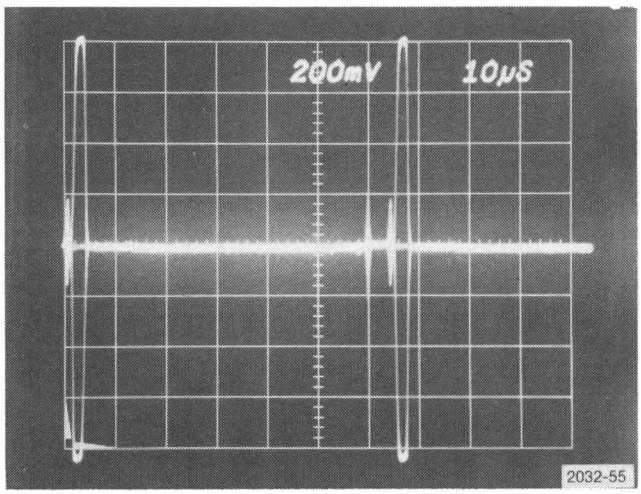

Fig. 5-14. 1421, 1422 — Differential Phase setup.

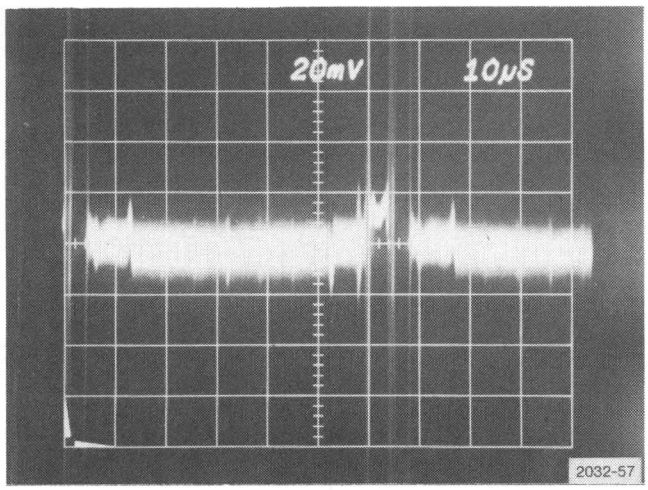

Fig. 5-16. 1421, 1422 — Differential Phase check.

16. Check Ext PAL Pulse Operation (1421 and 1422 only)

a. Adjust the PHASE control to place the +V and −V burst vector on their appropriate graticule markings.

b. Set the EXT SUB switch to EXT and the ϕ REF switch to A NTSC.

c. The −V burst vector should overlay the +V burst vector.

d. Remove the cable to the EXT PAL PULSE input.

e. Switch the ϕ REF switch back and forth until the +V burst vector overlays the −V burst vector. Leave the ϕ REF in the A NTSC position.

f. Reconnect the cable to the EXT PAL PULSE input.

g. CHECK—that the −V burst vector overlays the +V burst vector.

h. Repeat parts d through g as the PAL Pulse is varied between 1 V to 8 V p-p.

If using the 1411 or the 145-M generators, the amplitude of the PAL Pulse can be changed to 1 V p-p by connecting three 75 Ω feed-through terminators in series with the

cable to the EXT PAL PULSE input. The 8 V p-p PAL Pulse can be obtained by removing the termination to the EXT PAL PULSE input and internally changing the amplitude of the PAL Pulse from the generator. Refer to the generator's manual for information on changing the PAL Pulse amplitude.

17. Check Ext Subcarrier Drive

a. Set the ϕ REF switch to EXT (A NTSC; 1421, 1422) and the EXT SUB switch on the 1421 and 1422 to EXT.

b. Connect the 10X probe from the test oscilloscope input to TP1775 on the Demodulator board.

c. CHECK—for 0.8 V of Ext Subcarrier signal while varying the Ext Subcarrier Input between 1 V and 4 V p-p at the input loop-through connector. The subcarrier amplitude must not change more than ±50 mV at TP1775.

If using the 1410, 1411, or 145-M generators, the amplitude of the Ext Subcarrier can be varied to 4 V p-p by removing the 75 Ω terminator. 1 V p-p can be obtained by connecting three 75 Ω feed-through terminators in series with the cable and EXT SUB REF input.

NOTE

Test points in Steps 18 through 24 are found on the Demodulator circuit board (A1). See Demodulator Adjustment Locations pullout in Section 9.

Setup conditions for Steps 18 through 20 are illustrated in Fig. 5-17.

18. Check Quadrature Phase

a. Press the PUSH (TEST CIRCLE) button.

b. CHECK—that the test circles are overlaid. See Fig. 5-18.

c. Release the PUSH (TEST CIRCLE) button.

19. Check Position Control Range

a. Rotate the VERT POS control throughout its range.

b. CHECK—that the display origin moves at least 1/4 inch above and below graticule center.

c. Rotate the HORIZ POS control throughout its range.

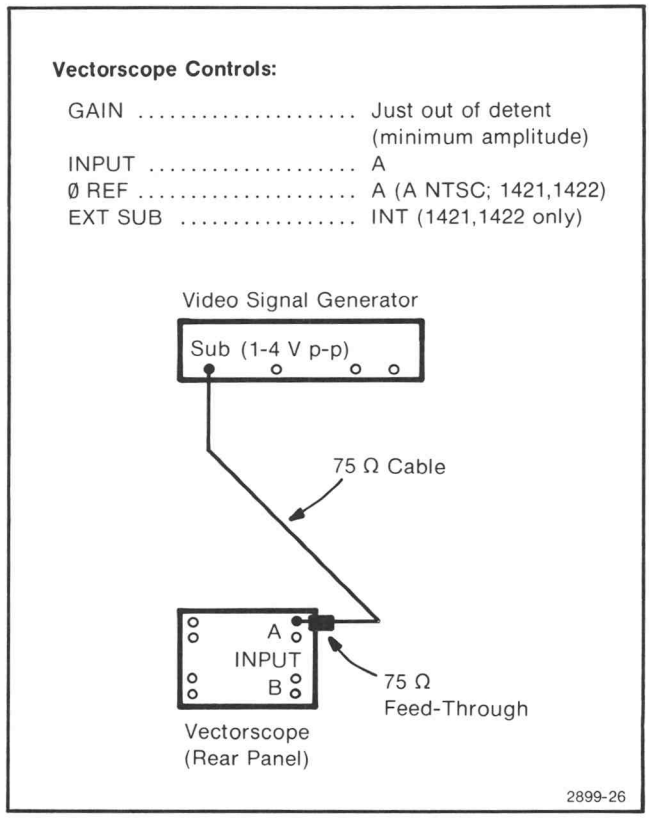

Fig. 5-17. Setup conditions for Steps 18—20.

d. CHECK—that the display origin moves at least 1/4 inch left and right of graticule center.

20. Check Clamp Stability

a. Center the display origin, using the position controls.

b. CHECK—that the display origin does not shift more than 1/64 inch as the PHASE control is rotated.

NOTE

Setup conditions for Step 21 are illustrated in Fig. 5-19.

21. Check Phase Shift versus Burst Amplitude

a. Adjust the GAIN control until the subcarrier vector is at the graticule edge.

b. Note the position of the subcarrier vector.

c. Remove the 75 Ω feed-through terminator from Channel B loop-through.

d. CHECK—that the subcarrier vector is within 2° of original position.

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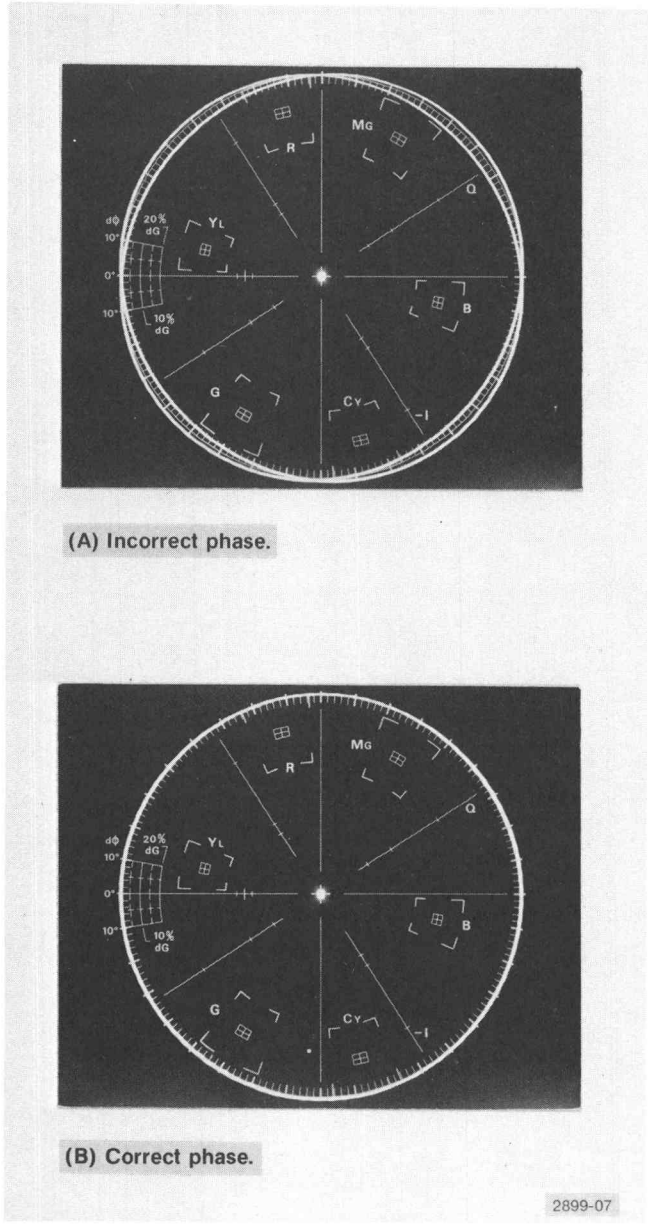

Fig. 5-18. Quadrature phase.

e. Connect three 75 Ω feed-through terminators in series to the Channel B loop-through input.

f. CHECK—that the subcarrier vector is within 2° of original position.

NOTE

Setup conditions for Steps 22 and 23 are illustrated in Fig. 5-20.

22. Check Gain

a. Adjust the function generator Frequency Hz and Frequency Vernier until the frequency indicated on the counter locks to the subcarrier.

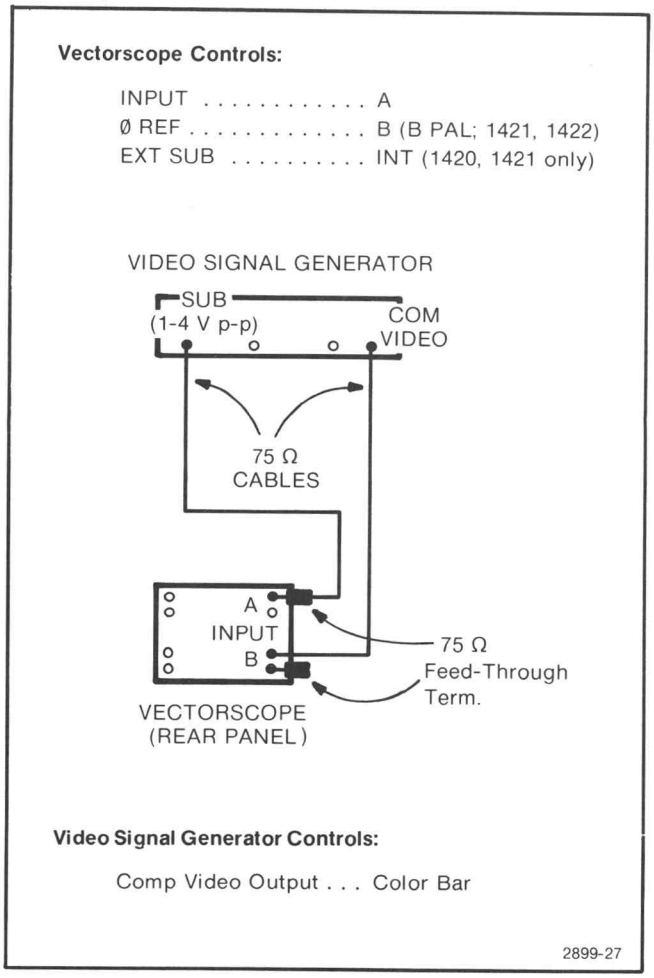

Fig. 5-19. Setup conditions for Step 21.

b. Connect the 10X probe from the test oscilloscope vertical input to TP1010 on the Demodulator board.

c. Adjust the sine-wave generator amplitude for 750 mV (1420); 796 mV (1421); 686 mV (1422), as observed on the test oscilloscope.

d. CHECK—that the display is within 1% of the graticule edge. See Fig. 5-21.

23. Check Chrominance Bandwidth

a. Adjust the sine-wave generator amplitude until the display falls on the graticule edge.

b. Decrease the sine-wave generator frequency until the display falls on the outer lines of the large blue and yellow graticule boxes (70% amplitude).

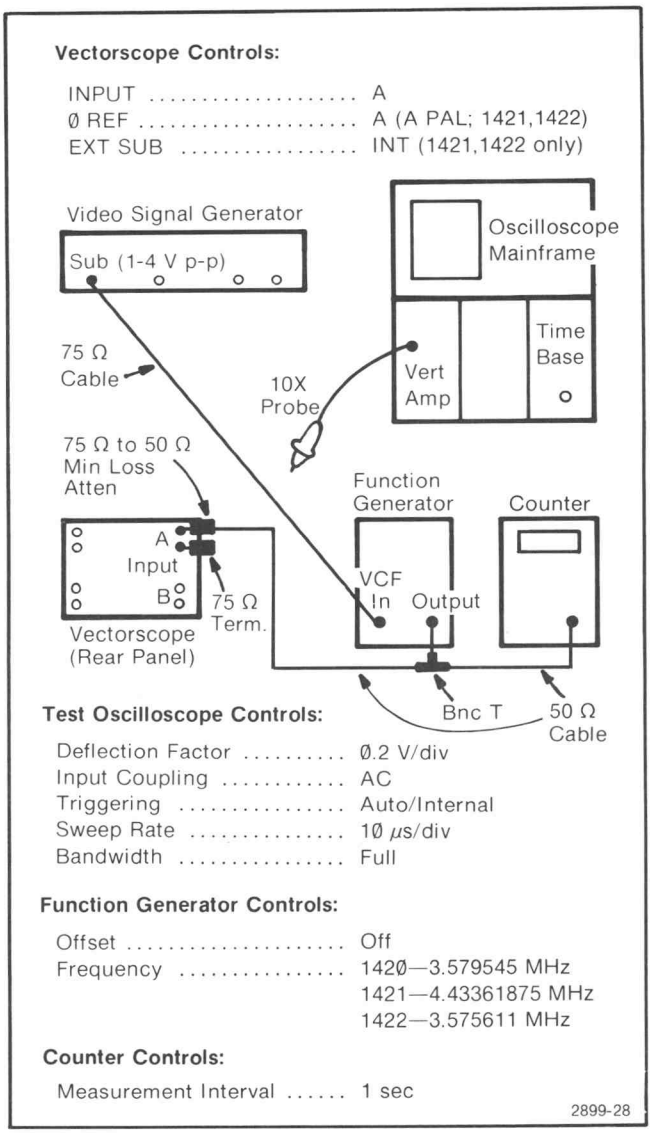

Fig. 5-20. Setup conditions for Steps 22 and 23.

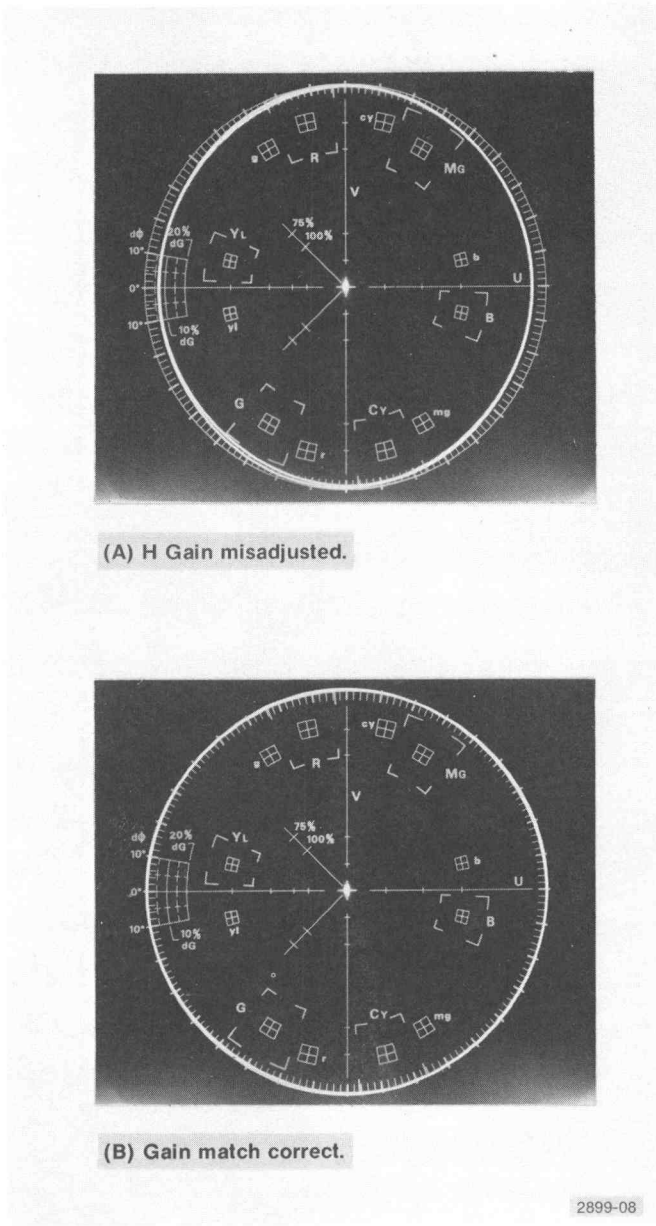

Fig. 5-21. Gain adjustment.

c. CHECK—that the frequency, as read on the digital counter is 2.979 MHz to 3.180 MHz (1420); 3.833 MHz to 4.033 MHz (1421); and 2.975 MHz to 3.176 MHz (1422).

d. Increase the sine-wave generator frequency until the display again falls on the outer lines of the blue and yellow graticule boxes.

e. CHECK—that the frequency, as read on the digital counter is 3.97 MHz to 4.180 MHz (1420); 4.833 MHz to 5.033 MHz (1421); and 3.975 MHz to 4.176 MHz (1422).

f. Set the sine-wave generator for 3.579545 MHz (1420); 4.43361875 MHz (1421); and 3.575611 MHz (1422).

NOTE

Setup conditions for Step 24 parts a and b are illustrated in Fig. 5-22 and Fig. 5-23.

24. Check Isolation

a. Adjust the function generator amplitude for 2 V p-p as seen on the test oscilloscope.

b. CHECK—that the amplitude of the subcarrier as monitored on the test oscilloscope changes 0.02 mV in trace width as the input cable is connected and disconnected.

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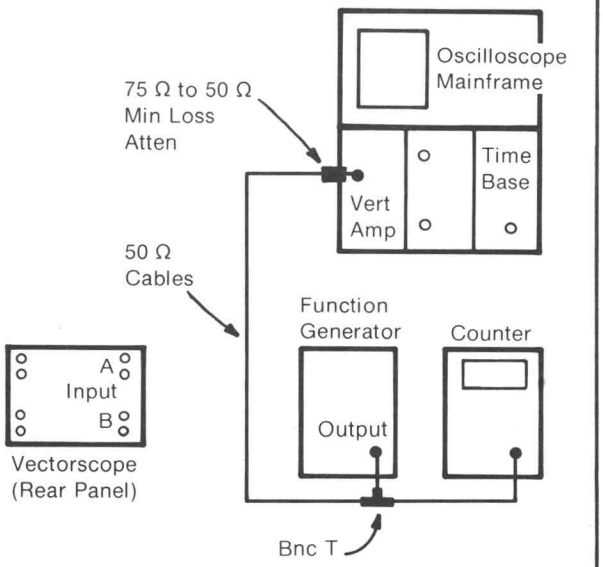


Test Oscilloscope Controls:

Deflection Factor	Ø.5 V/div
Input Coupling	AC
Triggering	Auto, Internal
Sweep Rate	1Ø µs/div
Bandwidth	5 MHz

Function Generator Controls:

Offset	Off
Frequency	1420—3.58 MHz 1421—4.43 MHz 1422—3.57 MHz

Counter Controls:

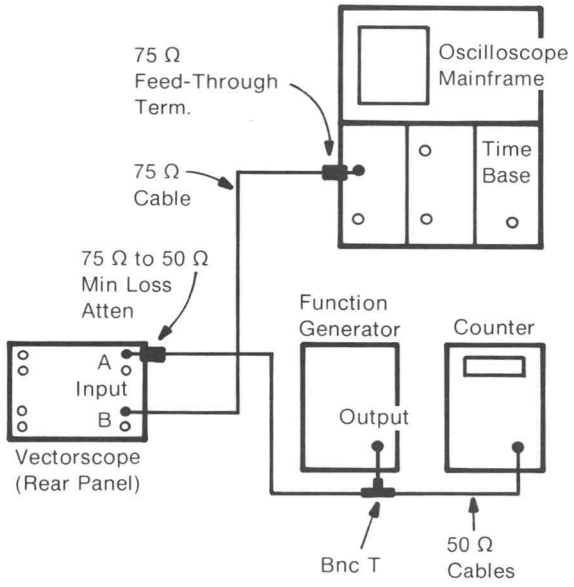
Measurement Interval	Ø.1 sec

2899-29

Fig. 5-22. Setup conditions for Step 24 part a.

Vectorscope Controls:

INPUT	A
Ø REF	A (A PAL; 1421,1422)
EXT SUB	INT (1421,1422 only)



Test Oscilloscope Controls:

Same as proceeding Setup except;

Deflection Factor	1 mV/div

2899-30

Fig. 5-23. Setup conditions for Step 24 part b.

NOTE

Set up conditions for Step 25 are illustrated in Fig. 5-24.

25. Check Return Loss

a. Remove the 75 Ω terminator from the Return Loss Bridge Unknown Arm.

b. Set the function generator Amplitude control for 500 mV output as monitored with the test oscilloscope Differential Comparator. Note amplitude as monitored on the test oscilloscope vertical amplifier channel.

c. Reconnect the 75 Ω terminator to the Return Loss Bridge Unknown Arm. Set the vertical deflection for the Differential Comparator channel to 1 mV/div. Note the amplitude of subcarrier monitored by the Differential Comparator channel.

d. Remove the 75 Ω terminator from the Return Loss Bridge Unknown Arm. Connect the Return Loss Bridge Unknown Arm to the Vectorscope A INPUT. Terminate the A INPUT loop-through with 75 Ω.

e. CHECK—that return loss does not exceed 2.5 mV as frequency is varied from 50 Hz to 5 MHz. Maintain constant sine-wave amplitude as monitored on the test oscilloscope vertical amplifier channel.

f. Repeat parts d and e for the B INPUT.

g. Connect the Return Loss Bridge Unknown Arm to the Vectorscope EXT SUB REFERENCE Input. Terminate the EXT SUB REFERENCE Input loop-through with 75 Ω.

h. CHECK—that return loss does not exceed 10 mV as frequency is varied from 50 Hz to 5 MHz. Maintain constant sine-wave amplitude as monitored on the test oscilloscope vertical amplifier channel.

i. Repeat parts g and h for the EXT PAL PULSE Input.

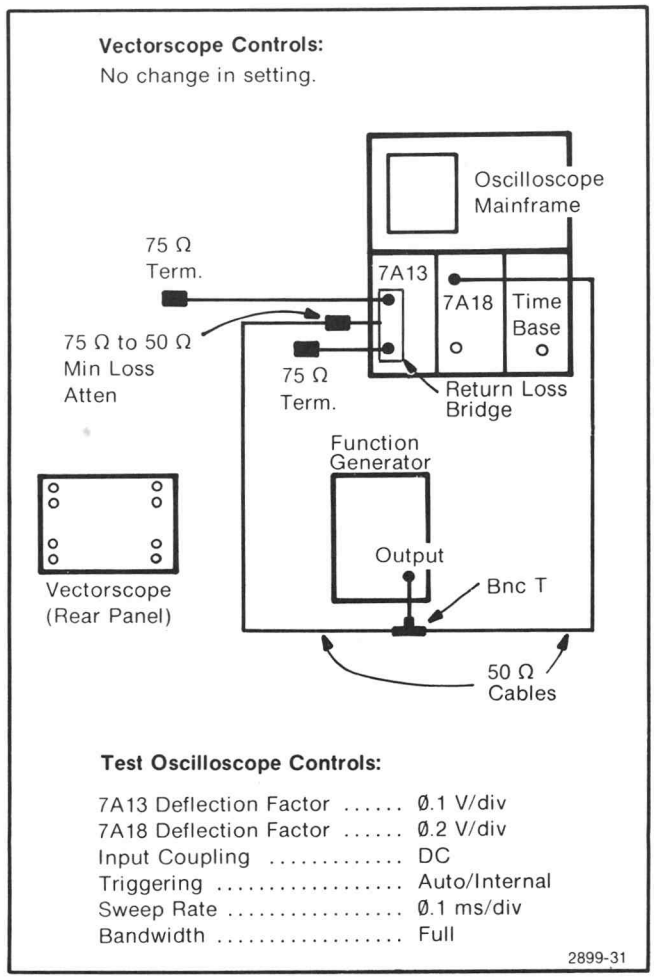


Fig. 5-24. Setup conditions for Step 25.

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ADJUSTMENT PROCEDURE

NOTE

The steps in the Adjustment Procedure are arranged in a sequential order to minimize interaction. Therefore, the steps in the Performance Check and the Adjustment Procedure are different.

Go through the Performance Check procedure first before making any adjustments. Do not make any adjustments unless it is essential to satisfy a performance parameter.

After completing the Adjustment Procedure, repeat the Performance Check to ensure that the performance of the instrument meets the specification.

NOTE

Test points and controls listed in Steps 1 through 5 are found on the Power Supply circuit board (A3). See Power Supply Adjustment Locations pullout in Section 9.

Setup conditions for Steps 1 through 5 are illustrated in Fig. 5-25.

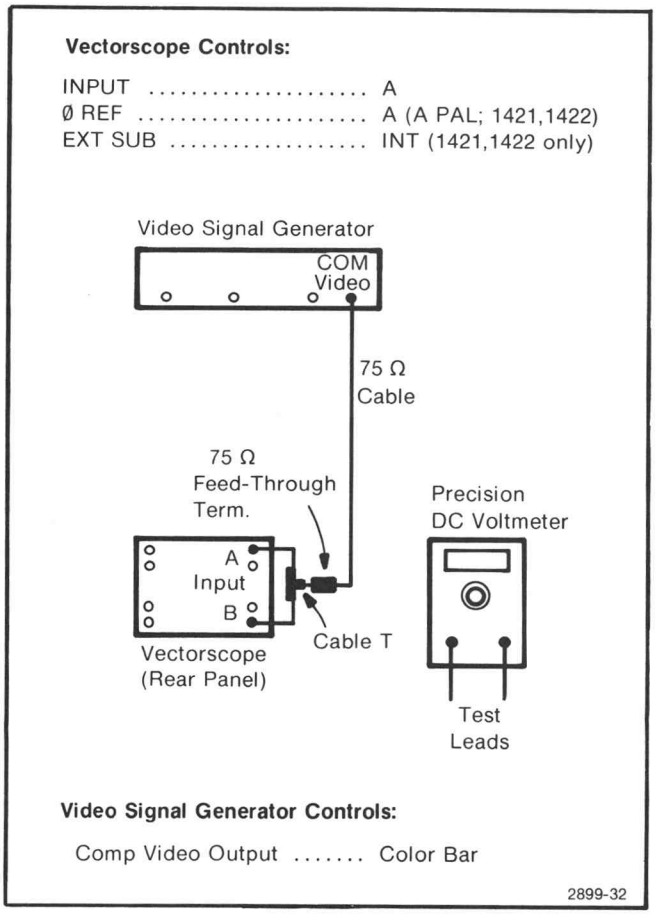

Fig. 5-25. Setup conditions for Steps 1—5.

Vectorscope Preliminary Control Settings:

POWER	On
SCALE ILLUM	Visible scale display
INTEN	Visible display
FOCUS	Well-defined display
VERT POS	Center the origin on horizontal center line
HORIZ POS	Center the orogin on vertical center line
GAIN	Cal position

1. Check/Adjust −15 V Supply

a. Connect the voltmeter between ground and the −15 V test point.

b. CHECK—that −15 V is −14.85V to −15.15 V.

c. ADJUST—R3115 (−15 V Adj) for −15 V.

2. Check +15 V Supply

a. Connect the voltmeter between ground and the +15 V test point.

b. CHECK—that the +15 V supply is +14.7 V to +15.3 V.

3. Check +210 V Supply

a. Set the voltmeter range to 1 k DC Volts.

b. Connect the voltmeter between ground and the +210 V test point.

c. CHECK—that the +210 V supply is +189.0 V to +231.0 V.

4. Adjust Intensity Limit

a. Rotate the INTEN control until the display is just visible.

b. Rotate the PHASE control until the chrominance vectors fall in their proper boxes.

c. ADJUST—R3769 (Inten Limit) for maximum brightness without amplitude change as the INTEN control is varied full range.

5. Adjust Astigmatism

a. Rotate HORIZ POS to set the display origin in a clear place in the graticule. Set FOCUS fully clockwise.

b. ADJUST—R3468 (Astig) on the Power Supply board until a round display origin is obtained.

c. Rotate the FOCUS control for a well-defined display.

NOTE

Test points and controls listed in Steps 6 through 16 are found on the Demodulator circuit board (A1). See Demodulator Adjustment Locations pullout in Section 9.

Set up conditions for Step 6 are illustrated in Fig. 5-26.

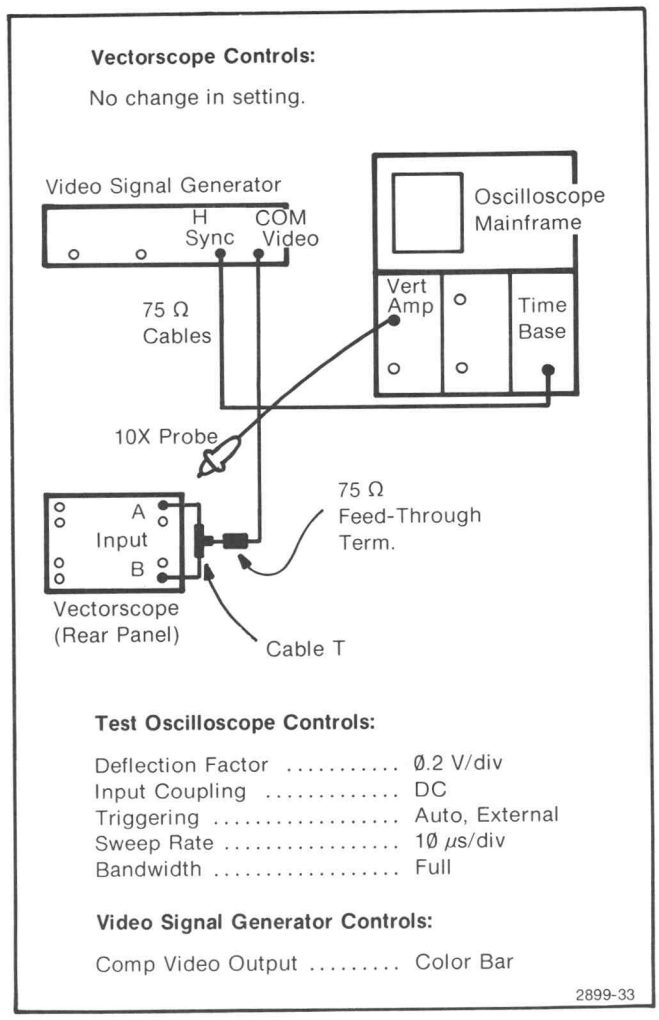

Fig. 5-26. Setup conditions for Step 6.

6. Adjust Input Compensation

a. Connect the 10X probe from the test oscilloscope to TP1010 on the Demodulator board.

b. ADJUST—C1034 (A Input Comp) for a flat top on the white bar and flat sync tip. See Fig. 5-27.

c. Move the 10X probe to TP1060.

d. ADJUST—C1084 (B Input Comp) for a flat top on the white bar and flat sync tip. See Fig. 5-27.

e. Remove the 10X probe.

NOTE

Setup conditions for Step 7 are illustrated in Fig. 5-28.

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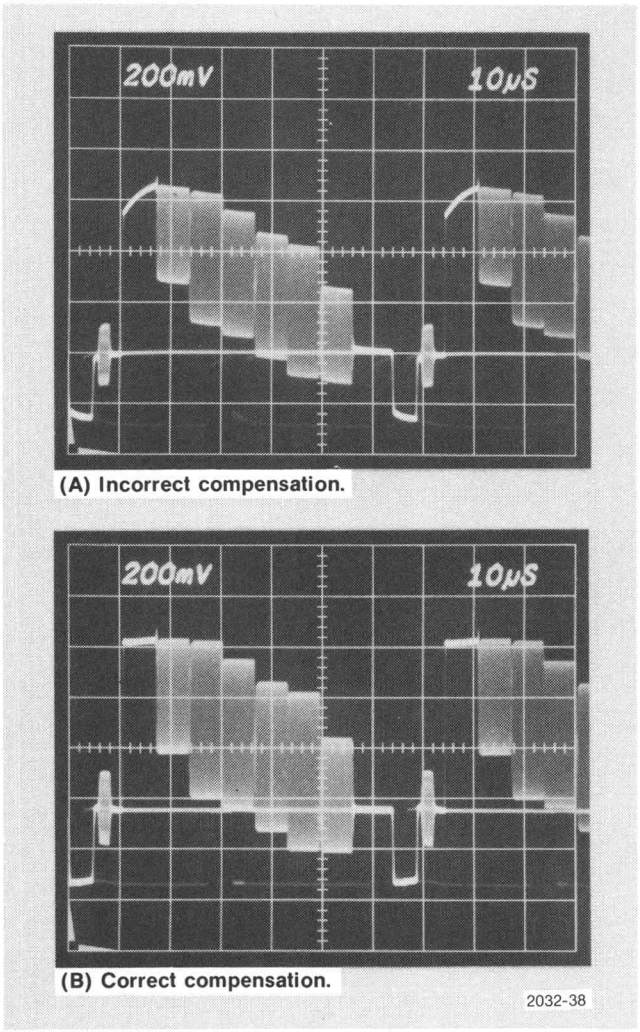


Fig. 5-27. Input compensation.

7. Adjust Quadrature Phase

a. Press the PUSH (TEST CIRCLE) button.

b. ADJUST—L1666 (Quad Phase) to overlay the test circles (see Fig. 5-29).

c. Release the PUSH (TEST CIRCLE) button.

NOTE

Setup conditions for Step 8 are illustrated in Fig. 5-30.

8. Adjust Gain

a. Connect the 10X probe from the test oscilloscope vertical input to TP1010 on the Demodulator board. Set the INPUT switch to A and ϕ REF to A (A VECTOR PAL; 1421, 1422).

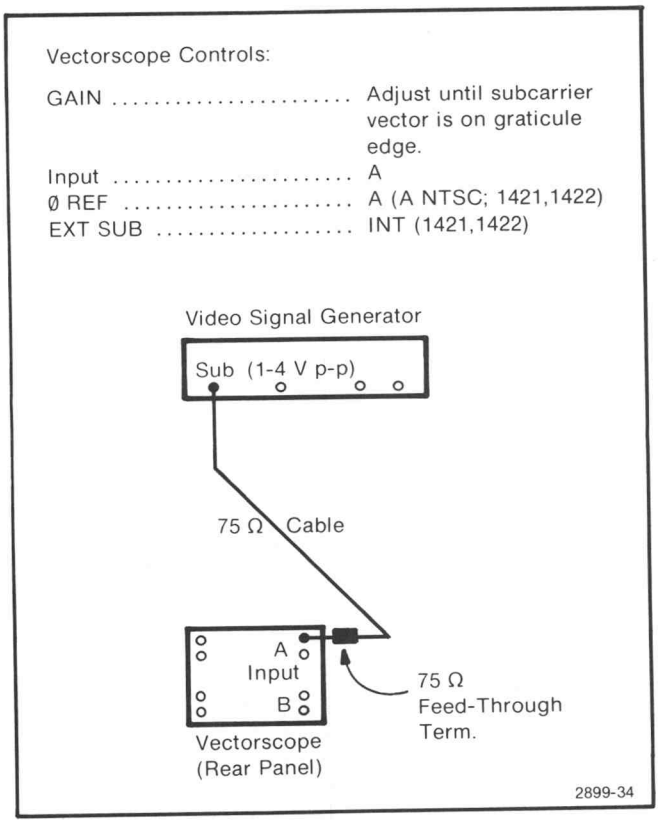


Fig. 5-28. Setup conditions for Step 7.

b. Adjust the sine-wave generator amplitude for 750 mV (1420); 796 mV (1421); 686 mV (1422), as observed on the test oscilloscope.

c. ADJUST—R1403 (Cal Gain) until the display amplitude is within 1% of the graticule edge on the R-Y (V) axis. See Fig. 5-31.

d. ADJUST—R1759 (H Gain) until the display amplitude is within 1% of the graticule edge on the B-Y (U) axis. See Fig. 5-31.

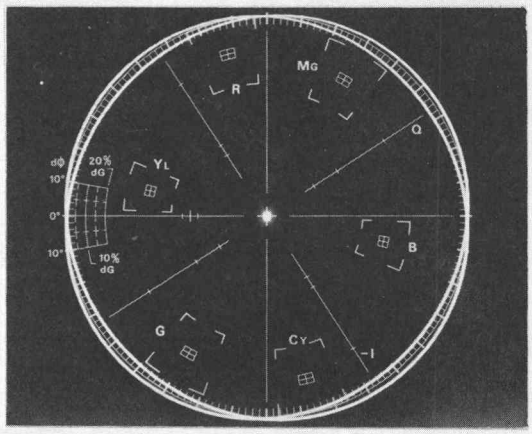
NOTE

Setup conditions for Steps 9 through 14 are illustrated in Fig. 5-32.

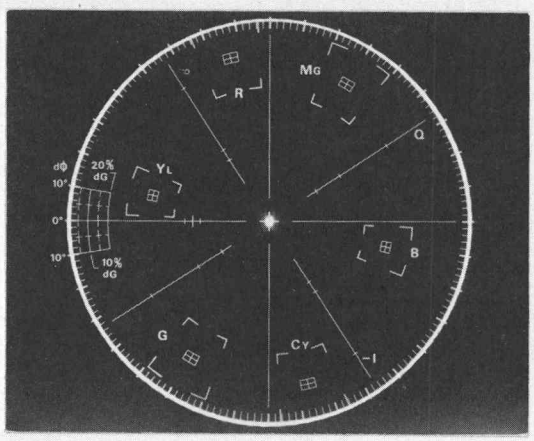
9. Adjust Input Phase Match

a. Set the output of the video generator for Color Bars.

b. Rotate the PHASE control to set all color dots at their proper graticule marks.



(A) Incorrect phase.



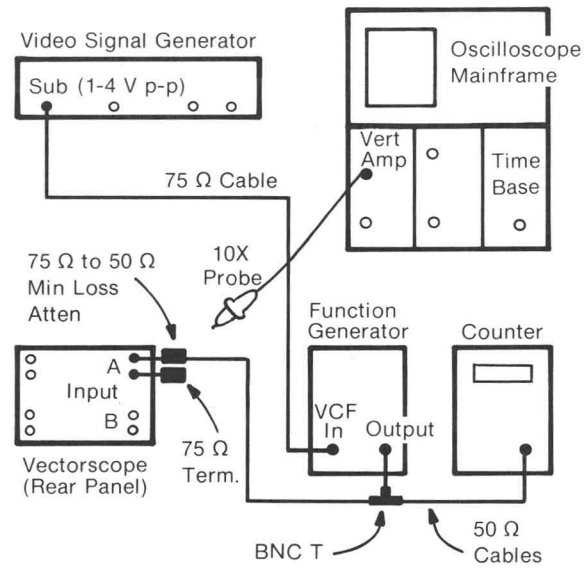
(B) Correct phase.

2899-07

Fig. 5-29. Quadrature phase.

Vectorscope Controls:

INPUT	A
Ø REF	A (A PAL; 1421,1422)
EXT SUB	INT (1421,1422 only)
GAIN	Cal



Test Oscilloscope Controls:

Deflection Factor	Ø.2 V/div
Input Coupling	AC
Triggering	Auto/Internal
Sweep Rate	1Ø μs/div
Bandwidth	Full

Function Generator Controls:

Offset	Off
Frequency	142Ø—3.579545 MHz 1421—4.43361875 MHz 1422—3.575611 MHz

Counter Controls:

Measurement Intervals:	1 sec

2899-35

Fig. 5-30. Setup conditions for Step 8.

c. Set the INPUT switch to B.

d. ADJUST—L1178 (B Phase Match) until the Channel B display is the same phase as the Channel A display.

NOTE

If L1178 has insufficient range to obtain the desired result, adjust L1118 (A Phase Match) until both channels are phased the same.

10. Adjust Phase Shift

a. Rotate the GAIN control to vary the display amplitude from minimum to the point at which the burst vector lies on the graticule edge.

b. ADJUST—L1305 (Phase Bal) for minimum phase shift with GAIN variation.

c. Rotate the GAIN control to set the burst vector on the graticule edge.

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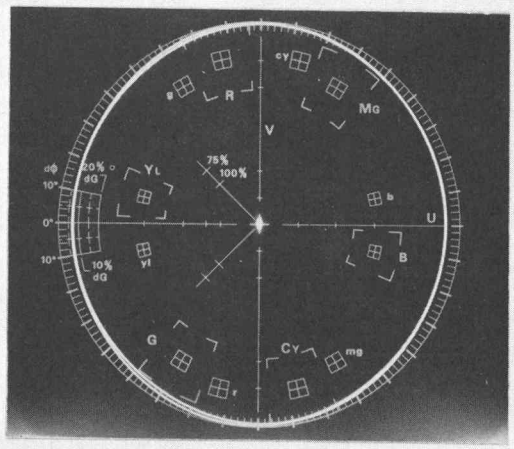
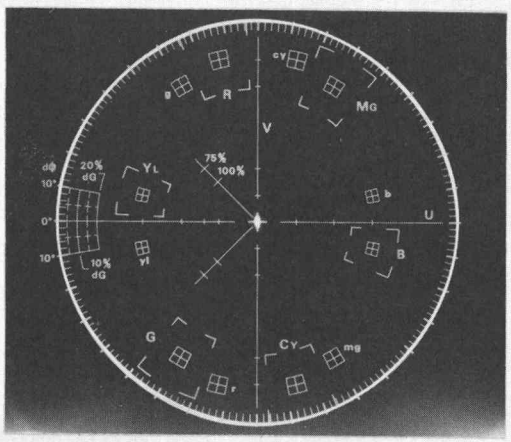


(A) H Gain misadjusted.



(B) Gain match correct.

2899-08

Fig. 5-31. Gain adjustment.

d. Move the INPUT switch back and forth between A and SUBCARRIER (A INPUT).

e. ADJUST—C1012 (Sub Ch Comp) for minimum phase shift as the INPUT switch is moved between A and SUBCARRIER (A INPUT).

11. Adjust Gain Match

a. Rotate the PHASE control until all chrominance portions of the display are at their proper graticule marks. Set the GAIN control to the CAL position.

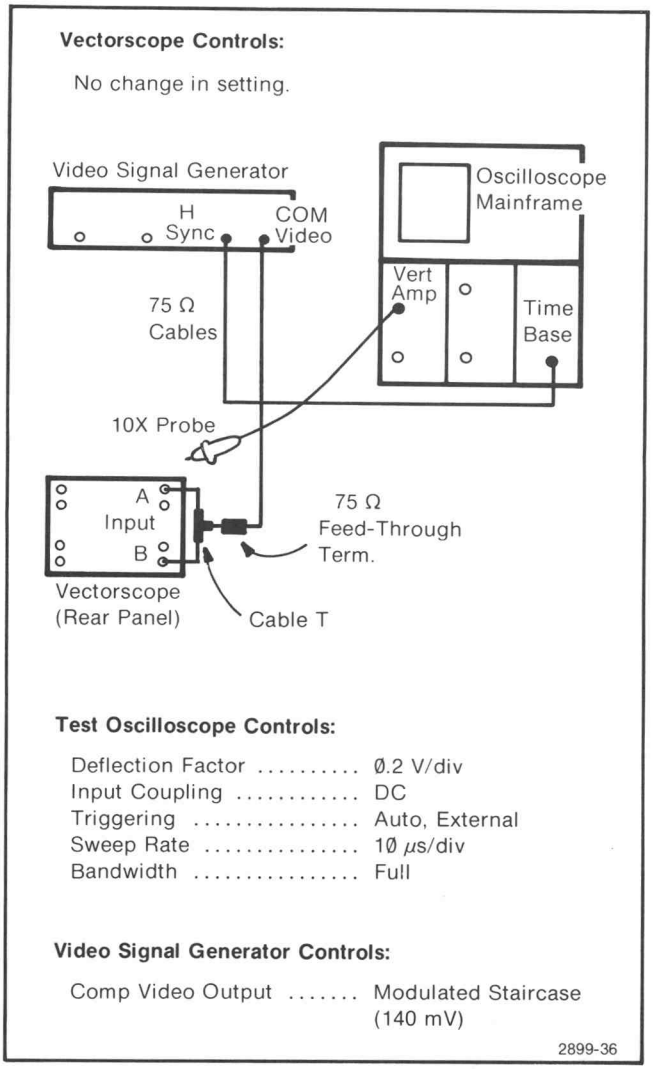


Fig. 5-32. Setup conditions for Steps 9—14.

b. Set the INPUT switch to B.

c. ADJUST—C1084 (B Input Comp) until the Chsnnel B display is the same amplitude as the Channel A display.

12. Adjust B-Y (U) and R-Y (V) Alignment

a. Set the ϕ REF switch to B.

b. Set the video generator Color Bar B-Y (U) switch off.

c. Press the PUSH (TEST CIRCLE) button about halfway in.

d. Rotate the PHASE control for best overlay of color dots.

e. ADJUST—R1916 (V Align) until all color dots fall within 1° of the R-Y (V) axis graticule line.

f. Set the video generator Color Bar B-Y (U) switch on, and Color Bar R-Y (V) switch off.

g. ADJUST—R1951 (H Align) until all color dots fall within 1° of the B-Y (U) axis graticule line.

h. Set the video generator Color Bar R-Y (V) switch on.

13. Adjust Filters

a. Connect the 10X probe from the test oscilloscope to TP1919.

b. ADJUST—L1821 and L1827 R-Y (V) Filter for best transient response of the demodulated R-Y (V) chrominance. See Fig. 5-33.

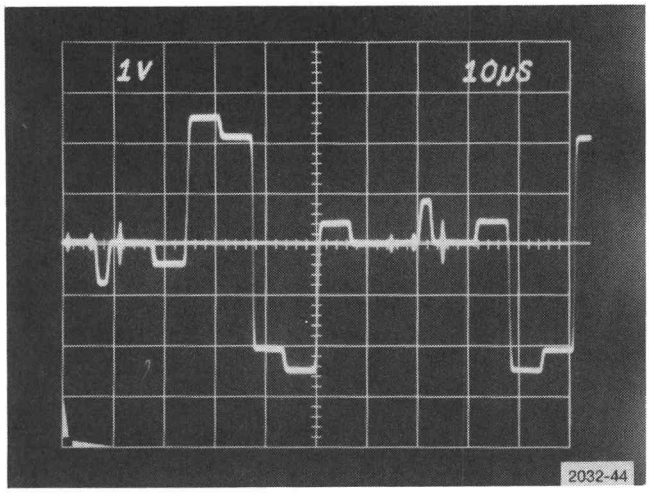


Fig. 5-33. Typical waveform at TP1919.

c. Move the 10X probe to TP1954.

d. ADJUST—L1841 and L1847 B-Y (U) Filter for best transient response of the demodulated B-Y (U) chrominance. See Fig. 5-34.

14. Adjust Deflection Amplifier Match

a. Remove the wire from P1950-1 and touch it to the wire in P1901-2. See Fig. 5-35. The Vectorscope display should be a line at a 45° angle.

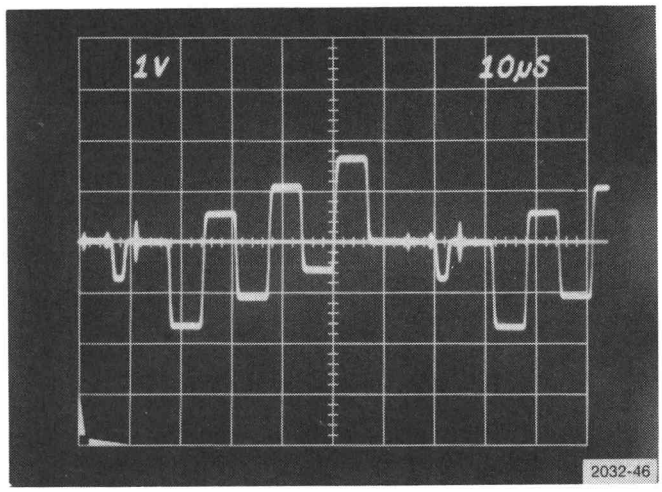


Fig. 5-34. Typical waveform at TP1954.

b. ADJUST—C2891 (Defl Comp) for the best display overlay, with no gap between lines.

c. Connect the wire removed in part a to P1950-1.

NOTE

Setup conditions for Steps 15 through 17 are illustrated in Fig. 5-36.

15. Adjust Oscillator Range

a. Connect the 1X probe from the digital counter to TP1775 on the Demodulator board. The digital counter will display the subcarrier frequency.

b. Connect a short piece of wire between P1699 and the + voltage pin.

c. ADJUST—R1554 (LF Adj) for subcarrier frequency minus 100 Hz.

d. Move the short piece of wire to connect P1699 to the − voltage pin.

e. ADJUST—R1652 (HF Adj) for subcarrier frequency plus 100 Hz.

NOTE

These two adjustments interact. Repeat as necessary to obtain the desired result.

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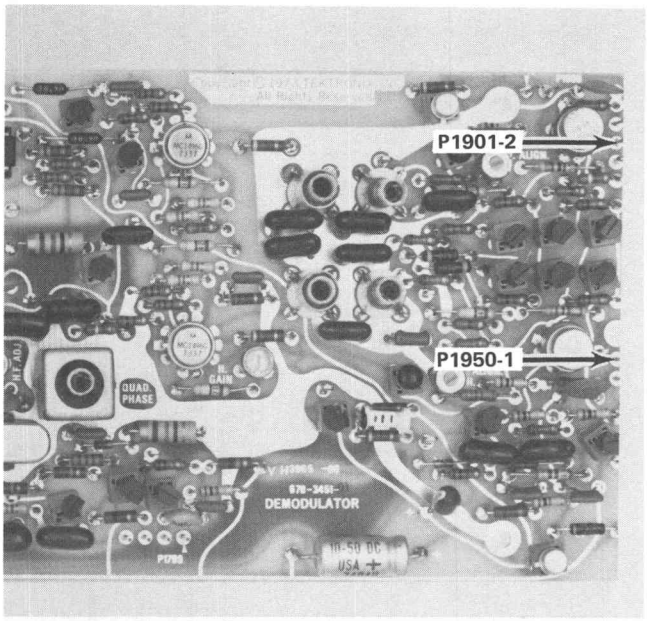

REMOVE THE WIRE
FROM P1950-1
AND TOUCH IT
TO P1901-2

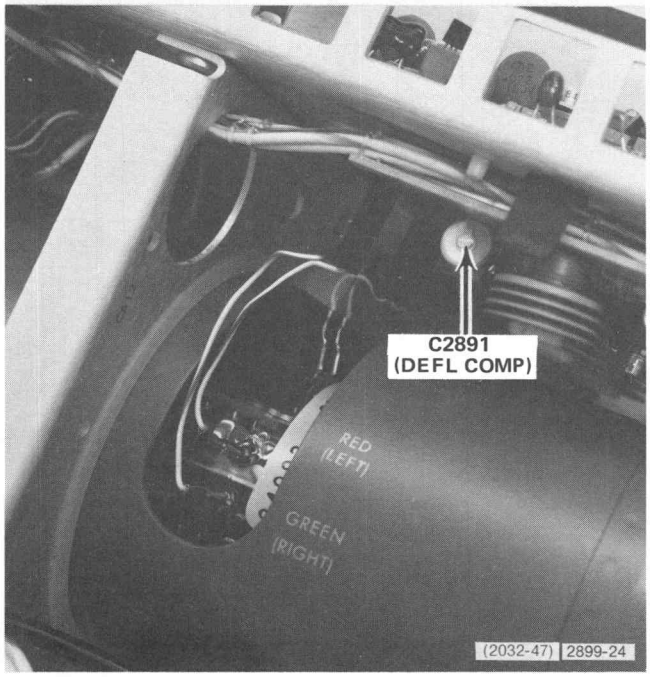

Fig. 5-35. Deflection compensation test points and control.

16A. Adjust DC Balance (1420)

a. Connect the 10X probe from the test oscilloscope to TP1544.

b. ADJUST—R1561 (DC Bal) until the test oscilloscope display is a straight line (see Fig. 5-37).

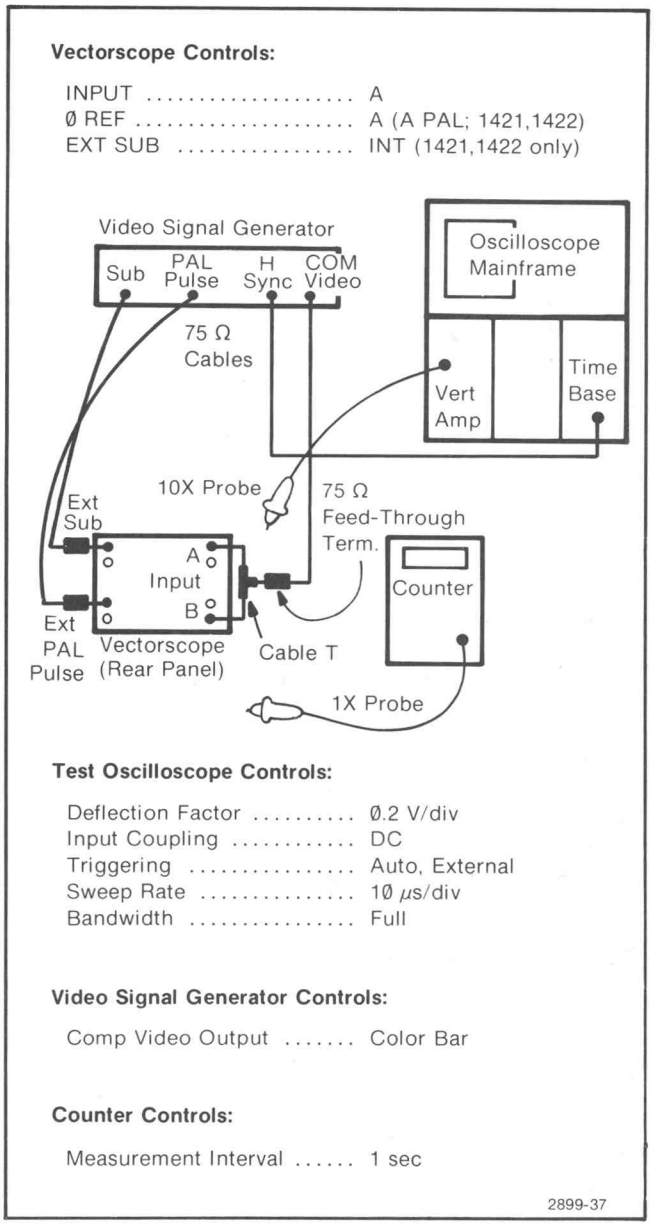

Fig. 5-36. Setup conditions for Steps 15—17.

16B. Adjust DC Balance (1421, 1422)

a. Connect the 10X probe from the test oscilloscope to TP1544. (See Fig. 5-38.) Turn the video generator Bruch Sequence off.

b. ADJUST—R1561 (DC Bal) until the crossover point of two successive field sync pulses, time overlaid, is 0 V dc (see Fig. 5-38).

NOTE

The test point and control listed in Step 18 is found on the External Subcarrier board (A4). See Sub-

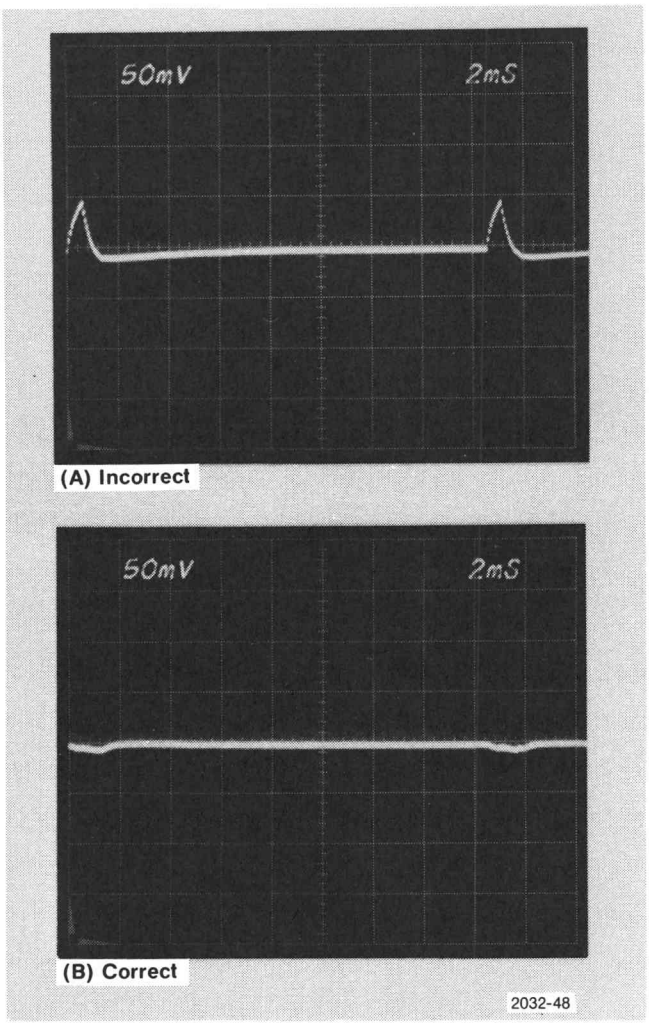

Fig. 5-37. 1420 — DC Balance adjustment.

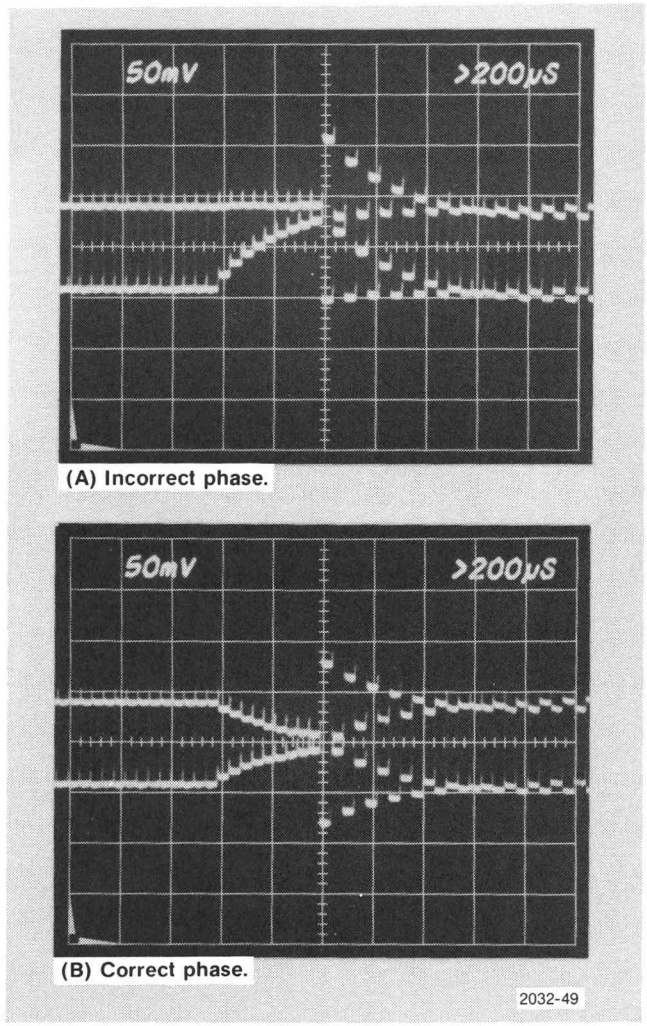

Fig. 5-38. 1421, 1422 — DC Balance adjustment.

carrier Reference & Switching Locations pullout in Section 9.

17. Adjust External Subcarrier Peaking

a. Set the ϕ REF switch to EXT (A PAL; 1421, 1422), the INPUT switch to A and the EXT SUB switch on the 1421 and 1422 to EXT.

b. Connect the 10X probe for the test oscilloscope input to TP1221 on the External Subcarrier board.

c. ADJUST—L1204 for the most positive dc level.

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MAINTENANCE

Introduction

The maintenance information contained in this section falls into two categories: Preventive Maintenance and Corrective Maintenance.

Preventive Maintenance includes inspection, cleaning, and semiconductor checks. Corrective Maintenance includes parts replacement, ordering information, troubleshooting techniques, and troubleshooting aids.

PREVENTIVE MAINTENANCE

A regular schedule of preventive maintenance can improve instrument reliability and can also prevent instrument breakdown. How often the preventive maintenance schedule is performed should be determined by the severity of the operating environment.

Visual Inspection

Visually inspect the instrument during the preventive maintenance routine for such defects as broken connections, loose or disconnected pin connectors, improperly seated transistors and integrated circuits, and damaged components.

The corrective procedure for most visible defects is obvious; however, care must be taken to determine and correct the cause of heat-damaged components.

Heat-damage is usually an indication of troubles elsewhere in the instrument.

Cleaning

Dirt, accumulating in the instrument, acts as an insulating blanket, preventive efficient heat dissipation, and possibly causing overheating and component breakdown. Accumulated dirt can also provide an electrical conduction path, especially under high humidity conditions.

CAUTION

Avoid the use of chemical cleaning agents which might damage the plastics used in this instrument. Avoid chemicals that contain benzene, toluene, xylene, or similar solvents.

Exterior. Remove accumulated dust with a soft cloth or small paint brush. The brush is particularly useful around the front panel controls.

Remaining dirt can be removed with a soft cloth, dampened in a mild detergent and water solution. Do not use abrasive cleaners.

CRT. Clean the crt face and face shield with a soft lint-free cloth dampened in denatured alcohol.

Interior. The best way to remove accumulated dust inside the instrument is to expel it with dry, low-velocity air. Remaining dirt can be removed with a small paint brush or a soft cloth, dampened in a mild detergent and water solution. A cotton-tipped applicator is useful in tight places.

Lubrication

The reliability of potentiometers, rotary switches, and other moving parts can be maintained if they are kept properly lubricated. Use a cleaning-type lubricant on switch contacts and a heavier grease on switch detents (for example, Tektronix Part No. 006-0219-00). Lubricate non-sealed potentiometers with a lubricant that does not affect electrical characteristics. The potentiometer lubricant can also be used on shaft bushings. Do not overlubricate.

A kit containing the necessary lubricants and instructions may be ordered from Tektronix, Inc. Order Tektronix Part No. 003-0342-02.

Transistor and Integrated Circuit Checks

Periodic transistor and integrated circuit checks are not recommended. The best performance check for these devices is actual operation in the instrument. Performance of the circuit is thoroughly checked during the performance check or calibration procedure. Any substandard transistors or integrated circuits will usually be detected at that time.

Recalibration

To ensure measurement accuracy, check instrument calibration every 1000 hours of operation or every six

months, if used infrequently. Replacement of components may also necessitate recalibration of the affected circuits.

The calibration procedure can also be helpful in localizing certain troubles, or minor troubles can sometimes be revealed and corrected by recalibration.

CORRECTIVE MAINTENANCE

Information presented here includes troubleshooting aids and techniques, and component ordering and replacement information.

Troubleshooting Aids

Diagrams. Circuit diagrams are provided on foldout pages at the rear of the manual. Each component, its electrical value, and circuit numbers are shown on the diagram.

Each diagram has been assigned a diagram number and a title. For example, the first diagram has been assigned the number 1, and is titled Input Processing. The diagrams are divided into functional blocks bordered by gray lines. Notice that Diagram 1 contains blocks named A Input Amplifier, B Input Amplifier, Signal Switching, Gain Cell and Control, Demodulator Driver, Sync Stripper, and Lamp Switch. The Theory of Operation in Section 4 is organized with respect to these and other blocks.

Circuit Board Illustration. Each circuit board is illustrated on the back side of the foldout page preceding the appropriate circuit diagram. Notice that the Demodulator board is illustrated on the back of the Block Diagram foldout and opposite Diagram 1. This allows for immediate correlation between the circuit diagram and the physical location of the parts in the circuit.

Circuit numbers are assigned on a grid system. For example, notice the Demodulator board illustration, opposite Diagram 1. The upper left corner of this board has been assigned numbers around 1000. Proceeding from left to right, the numbers increase toward 1100. From left to right across the bottom of the board, the numbers increase toward 1999. Using this method, the physical location of each component is readily available.

Wire Color Codes. All insulated wires used in this instrument are color-coded to aid in circuit tracing. Tables 6-1 and 6-2 summarize wire color codes used in this instrument.

Table 6-1

NEC Color Code	Significance
White[a]	Signal
Red[b]	B+
Violet[b]	B−

[a]Color stripes are used on these wires as an aid to circuit tracing.

[b]Color stripe on wire indicates position of supply with respect to 0 Volts. A black stripe on a red wire would be the first voltage in a positive direction. If a second stripe is used (white only), it indicates an unregulated supply.

Table 6-2

POWER CORD CONDUCTOR IDENTIFICATION

Conductor	Color	Alternate Color
Ungrounded (Line)	Brown	Black
Grounded (Neutral)	Blue	White
Grounding (Earthing)	Green-Yellow	Green-Yellow

Resistor Color Code. Resistors used in this instrument are standard parts. Most are composition, with some metal film types. They are color-coded with the standard EIA color code (see Fig. 6-1).

Capacitor Marking. The electrical value of common disc capacitors and electrolytics used in this instrument are marked in microfarads on the component body. The white ceramic capacitors are color-coded in picofarads using a modified EIA code (see Fig. 6-1). Tantalum slug capacitors are color-coded in picofarads, using a modified EIA code with the dot indicating both voltage rating and the positive side (see Fig. 6-2).

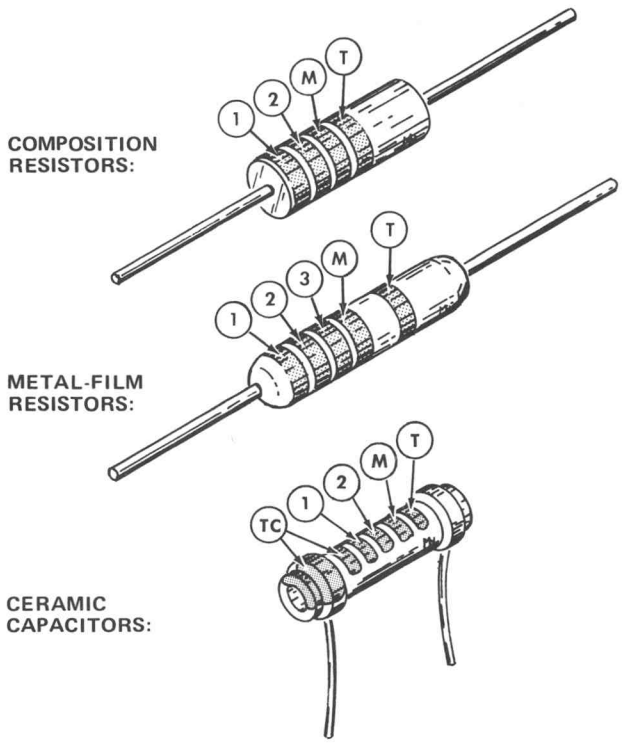
Troubleshooting Techniques

Troubleshooting should proceed in a logical sequence that checks the simple possibilities before beginning detailed analysis of the circuit involved.

Check Control Settings. Incorrect control settings can set off a chase for problems that do not exist. Read the Operating Instructions section of this manual if questions arise concerning the correct function or operation of any control.

Check Operation of Associated Equipment. Make sure that interconnections and terminations are correct. Look

@



(1) (2) and (3) —1st, 2nd and 3rd significant figures;
(M) —multiplier; (T) —tolerance;
(TC) —temperature coefficient.

RESISTOR AND CAPACITOR COLOR CODE

Color	Significant Figures	Multiplier		Tolerance	
		Resistors	Capacitors	Resistors	Capacitors
Silver	---	10^{-2}	---	±10%	---
Gold	---	10^{-1}	---	±5%	---
Black	0	1	1	---	±20% or 2 pF*
Brown	1	10	10	±1%	±1% or 0.1 pF*
Red	2	10^{2}	10^{2}	±2%	±2%
Orange	3	10^{3}	10^{3}	±3%	±3%
Yellow	4	10^{4}	10^{4}	±4%	+100% —0%
Green	5	10^{5}	10^{5}	±0.5%	±5% or 0.5 pF*
Blue	6	10^{6}	10^{6}	---	---
Violet	7	---	---	---	---
Gray	8	---	10^{-2}	---	+80% —20% or 0.25 pF*
White	9	---	10^{-1}	---	±10% or 1 pF*
(none)	---	---	---	±20%	±10% or 1 pF*

*For capacitance of 10 pF or less. 0614-1

NOTE: (T) and/or (TC) color code for capacitors depends upon manufacturer and capacitor type. May not be present in some cases.

Fig. 6-1. Standard EIA color coding for resistors and capacitors.

for faulty cables or incorrect settings on signal source. Be positive before troubleshooting the Vectorscope, that the Vectorscope is at fault.

Isolate Trouble to a Circuit. Visible symptoms can often point at the circuit at fault. For example, if there is no horizontal deflection of the display, the logical starting point is the B-Y (U) Deflection Amplifier. Then work back through the circuits by taking voltage and waveform readings to find the trouble.

If the operation of all circuits is faulty, the trouble may be in the power supply. Check for correct power supply voltages. (See Steps 1 through 3 of the Performance Check/Adjustment Procedure in this Manual.) Occasionally, a defective component elsewhere in the instrument can cause a load on the power supply that looks like a power supply failure.

Visual Check. Visually inspect that portion of the instrument in which the trouble is located. Look for poor solder connections, broken wires, damage to the circuit board, damaged components, loose pin connectors, or incorrectly connected pin connectors, etc.

Pin connectors provide a convenient means of circuit isolation. For example, a short in a power supply can be isolated by disconnecting the power distribution pin connectors when making resistance to ground checks.

Check Voltages and Waveforms. Often, a defective component can be located by checking for the correct voltage or waveform in the circuit. Typical waveforms are shown in the Diagrams section. The waveforms are not absolute and may vary slightly between instruments.

CAUTION

Due to component density on circuit boards, care should be taken with meter leads and probe tips. Accidental shorts can cause abnormal voltages or transients that may destroy components. "Ground lugs" are not always at ground potential. Check the diagrams before using such connections as ground

Rated Voltage VDC 25°C	Color	CODE FOR CAPACITANCE IN PICOFARADS		
		1st Figure	2nd Figure	Multiplier—pF
4	Black	0	0	None
6	Brown	1	1	X 10
10	Red	2	2	X 10^2
15	Orange	3	3	X 10^3
20	Yellow	4	4	X 10^4
25	Green	5	5	X 10^5
35	Blue	6	6	X 10^6
50	Violet	7	7	X 10^7
	Gray	8	8	
3	White	9	9	

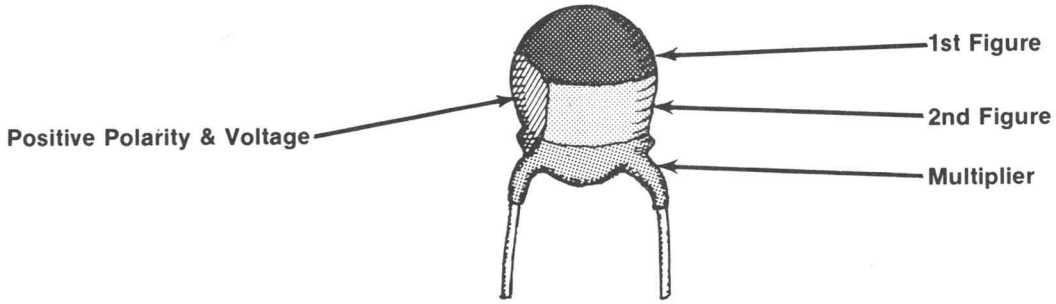


Fig. 6-2. Color coding for dipped tantalum capacitors.

for meter prods or oscilloscope probes. Some transistor cases may be elevated.

Check Individual Components. Methods of checking passive components are fairly obvious. If there is any doubt about isolation of a soldered-in component, unsolder one end.

Diodes can be checked for open or shorted conditions by measuring front and back resistance between terminals. Use an ohmmeter scale with an internal source voltage between 800 millivolts and 3 volts. Resistance should be very high in the back direction, and very low in the forward direction.

CAUTION

Do not use an ohmmeter scale that has high internal current. High current may damage the diode.

Transistor operation is best checked by performance in an operating circuit. If a transistor is suspected of being defective, substitute a new transistor. Be certain that abnormal circuit conditions that could damage the new transistor do not exist. If a substitute transistor is not available, use a dynamic transistor tester such as a TEKTRONIX Type 576. Static-type testers are not recommended since they do not simulate operating conditions

Repair and Readjust the Circuit. If a defective component is located, follow the replacement information given in this section of the manual. Check the performance of any circuit that has been repaired or that has had any electrical components replaced.

Static-Sensitive Components

CAUTION

Static discharge can damage any semiconductor component in this instrument.

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This instrument contains electrical components that are susceptible to damage from static discharge. See Table 6-3 for relative susceptibility of various classes of semiconductors. Static voltages of 1 kV to 30 kV are common in unprotected environments.

Observe the following precautions to avoid damage:

1. Minimize handling of static-sensitive components.

2. Transport and store static-sensitive components or assemblies in their original containers, on a metal rail, or on conductive foam. Label any package that contains static-sensitive assemblies or components.

3. Discharge the static voltage from your body by wearing a wrist strap while handling these components. Servicing static-sensitive assemblies or components should be performed only at a static-free work station by qualified service personnel.

4. Nothing capable of generating or holding a static charge should be allowed on the work station surface.

5. Keep the component leads shorted together whenever possible.

6. Pick up components by the body, never by the leads.

7. Do not slide the components over any surface.

8. Avoid handling components in areas that have a floor or work-surface covering capable of generating a static charge.

9. Use a soldering iron that is connected to earth ground.

10. Use only special antistatic suction type or wick type desoldering tools.

Table 6-3

RELATIVE SUSCEPTIBILITY TO STATIC DISCHARGE DAMAGE

Semiconductor Classes	Relative Susceptibility Levels[a]
MOS or CMOS microcircuits or discretes or linear microcircuits with MOS inputs. (Most Sensitive)	1
ECL	2
Schottky signal diodes	3
Schottky TTL	4
High-frequency bipolar transistors	5
JFETs	6
Linear microcircuits	7
Low-power Schottky TTL	8
TTL (Least Sensitive)	9

[a]**Voltage equivalent for levels:**

1 = 100 to 500 V
2 = 200 to 500 V
3 = 250 V
4 = 500 V
5 = 400 to 600 V
6 = 600 to 800 V
7 = 400 to 1000 V (ext.)
8 = 900 V
9 = 1200 V

(Voltage discharged from a 100 pF capacitor through a resistance of 100 ohms.)

Replacement Parts

Ordering. All electrical and mechanical replacement parts can be obtained through the local Tektronix Field Office or representative. Many of the standard electronic components can be obtained locally in less time than is required to order from Tektronix, Inc. Before purchasing or ordering replacement parts, consult the parts list for value, tolerance, and rating.

When ordering replacement parts from Tektronix, Inc., include the following information:

1. Instrument type.

2. Instrument serial number.

3. Description of the part (if electrical, include circuit number).

4. Tektronix Part Number.

NOTE

When selecting replacement parts, it is important to remember that physical size and shape of a component may affect its performance at high frequencies.

Transistors and Integrated Circuits. Transistors and integrated circuits should not be replaced unless actually defective. Replacement or exchanges of components may affect the calibration of the instrument. If a transistor or integrated circuit is removed during routine maintenance, return it to its original socket.

Any replacement component should be of the original type or a direct replacement. Bend the leads to fit the socket and cut the leads to the same length as the original part. (See Fig. 6-4 for basing diagrams.)

After any component is replaced, check the operation and calibration of the associated circuits.

Circuit Boards. If a circuit board is damaged beyond repair, the entire assembly, including all soldered-on parts, can be replaced.

Multiple Terminal Connector Holders. Most interconnections between circuit boards, or between chassis-mounted components and circuit boards, are made through pin connectors. The terminals in the connector holders are identified with numbers. Connector orientation to the circuit board is keyed with triangles, one on the holder, and one on the circuit board. (See Fig. 6-3.)

Power Transformer. If the power transformer becomes defective, contact the local Tektronix Field Office or representative. Replace only with direct replacement Tektronix transformer.

Cathode-Ray Tube. Use care when handling the cathode-ray tube. Protective clothing and safety glasses should be worn. Do not strike it on any object that might cause it to crack or implode. When storing a cathode-ray tube, place it face down on a smooth surface with a protective cover or soft mat under the faceplate to protect it from scratches.

Cathode-Ray Tube Removal. Use the following procedure to remove the cathode-ray tube:

1. Remove the four deflection-plate leads as shown in Fig. 6-6a. Do not bend the cathode-ray tube deflection-plate pins.

2. Remove the plastic bezel as shown in Fig. 6-6b.

3. Remove the four Phillips-head screws holding the faceplate protector as shown in Fig. 6-6c.

4. Remove the faceplate protector.

5. Remove the rear panel cathode-ray tube base cover plate as shown in Fig. 6-6d.

6. Remove the cathode-ray tube socket as shown in Fig. 6-6e.

7. Turn the clamp screw (Fig. 6-6e) until the cathode-ray tube will slide within the clamp.

8. Push on the cathode-ray tube base to slide the tube forward. Pull the cathode-ray tube out of the shield from the front. Make certain that the deflection-plate pins clear the shield.

CAUTION

Handle with care. The high vacuum existing inside a cathode-ray tube creates an implosion hazard that increases with rough handling or scratches on the external surface.

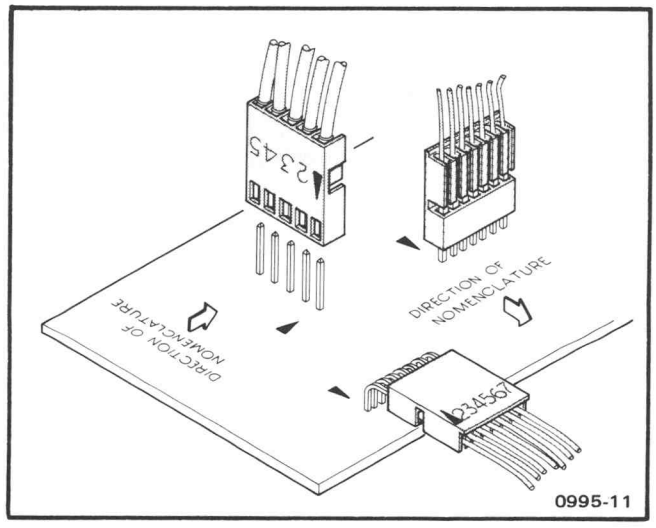


Fig. 6-3. Multiple pin connector holders.

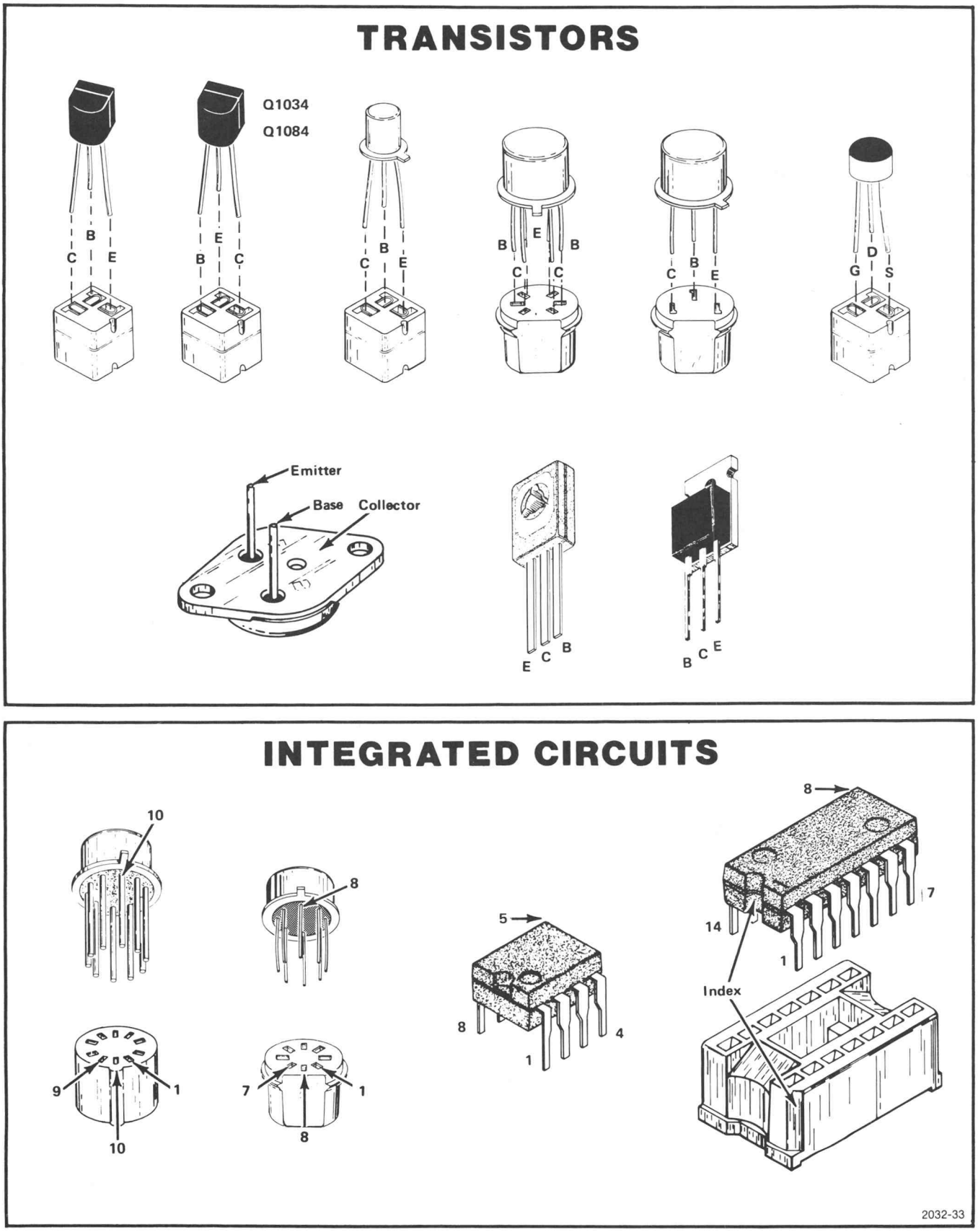
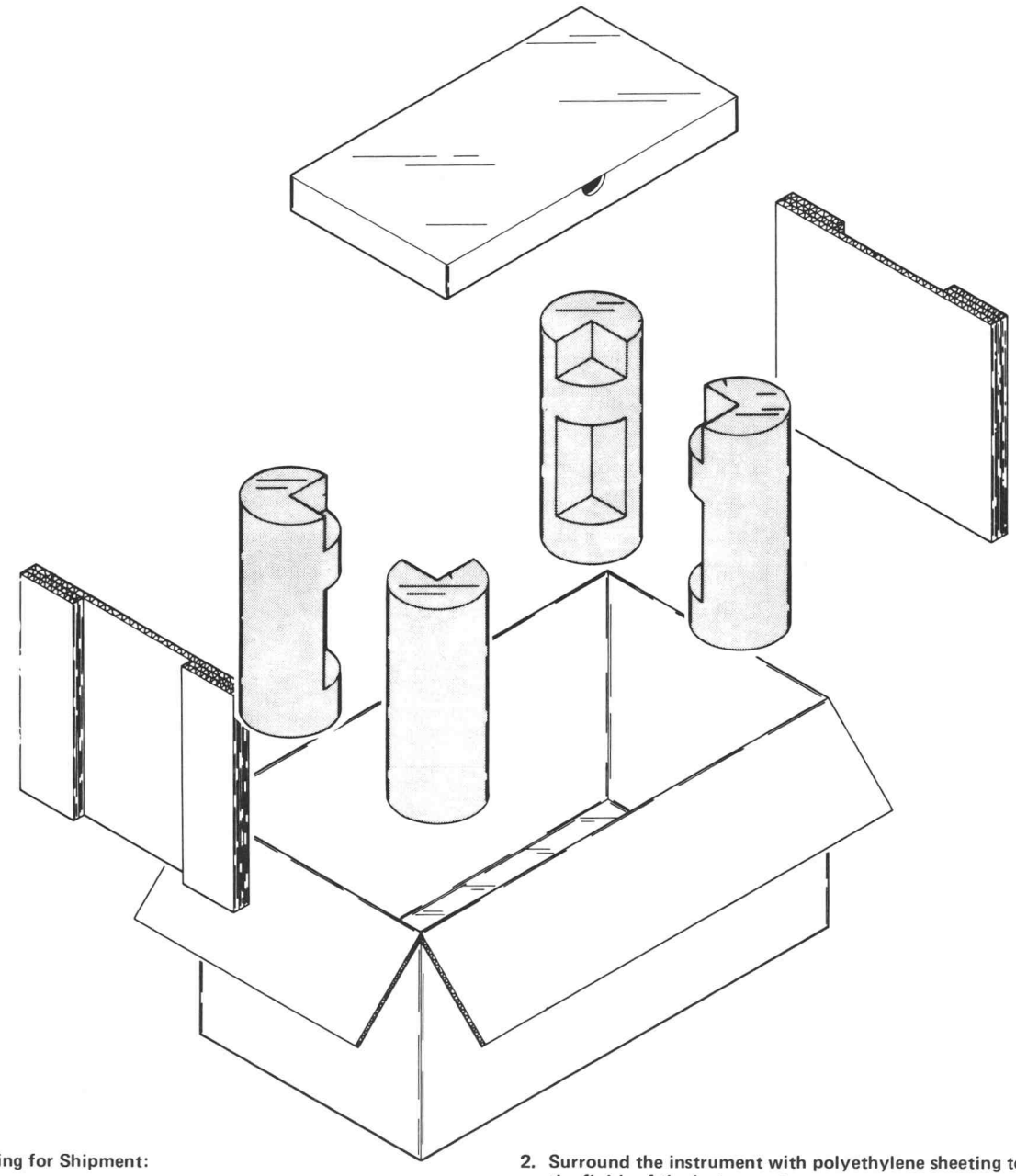


Fig. 6-4. Transistor and integrated circuit basing diagrams.



Repackaging for Shipment:

If the Tektronix instrument is to be shipped to a Tektronix Service Center for service or repair, attach a tag showing: owner (with address) and the name of an individual at your firm that can be contacted, complete instrument serial number and a description of the service required.

Save and re-use the package in which your instrument was shipped. If the original packaging is unfit for use or not available, repackage the instrument as follows:

1. Obtain a carton of corrugated cardboard having inside dimensions of no less than six inches more than the instrument dimensions; this will allow for cushioning. Refer to Table 1 for carton test strength requirements.
2. Surround the instrument with polyethylene sheeting to protect the finish of the instrument.
3. Cushion the instrument on all sides by tightly packing dunnage or urethane foam between carton and instrument, allowing three inches on all sides.
4. Seal carton with shipping tape or industrial stapler.

Table 1. Shipping Carton Test Strength.

Gross Weight (lb.)	Carton Test Strength (lb.)
0–10	200
10–30	275
30–120	375
120–140	500
140–160	600

2032-35

Fig. 6-5. Instrument repacking.

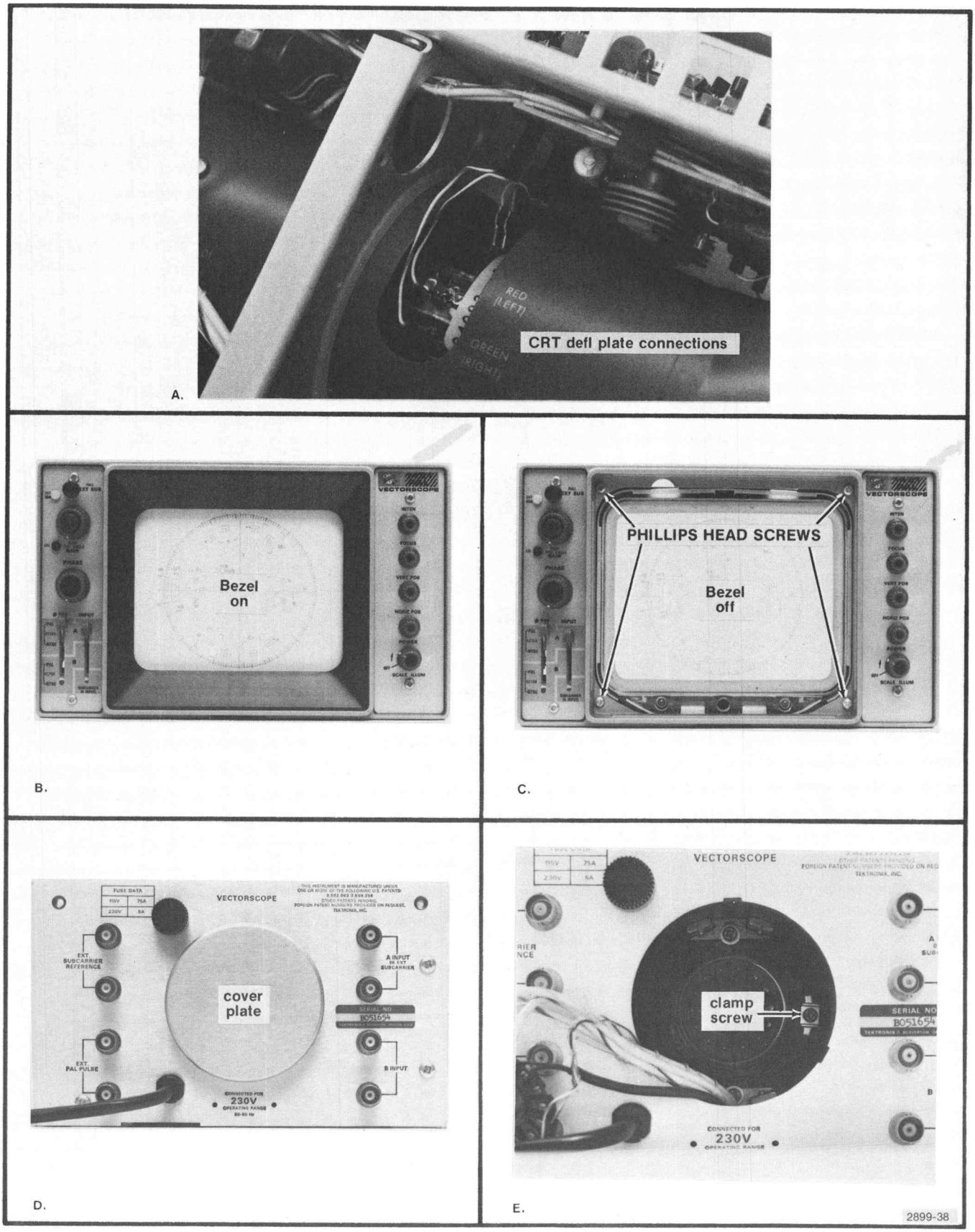


Fig. 6-6. Vectorscope CRT removal.

Cathode-Ray Tube Installation. Use the following procedure to install the cathode-ray tube.

1. Slide the tube into the shield. Do not bend the deflection-plate pins.

2. Guide the tube into the base clamp. Slide the cathode-ray tube far enough to the rear for the faceplate protector to be replaced.

3. Mount the faceplate protector, using the four Phillips-head screws.

4. Push the cathode-ray tube forward until the faceplate touches the faceplate protector.

5. Tighten the clamp screw.

6. Replace the cathode-ray tube socket, and install the rear-panel base cover.

7. Replace the deflection-plate pin connectors. Do not bend the deflection-plate pins.

8. Snap on the plastic bezel.

OPTIONS

This section documents catalog options for the 1420, 1421, and 1422 Vectorscopes. Custom modifications are negotiated and documented separately.

Option 1—No Metal Cabinet

The instruments are normally shipped in metal cabinets (Tektronix Part No. 437-0100-01). If the metal cabinet is not desired, order Option 1.

Option 2—Field Case

For portable use, a blue-vinyl painted aluminum case (Tektronix Part No. 390-0018-01) with handle and rubber feet is available. It can be ordered separately, or if the instrument is not intended for rack use, can be shipped on the instrument from the factory. Order Option 2.

REPLACEABLE ELECTRICAL PARTS

PARTS ORDERING INFORMATION

Replacement parts are available from or through your local Tektronix, Inc. Field Office or representative.

Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available, and to give you the benefit of the latest circuit improvements developed in our engineering department. It is therefore important, when ordering parts, to include the following information in your order: Part number, instrument type or number, serial number, and modification number if applicable.

If a part you have ordered has been replaced with a new or improved part, your local Tektronix, Inc. Field Office or representative will contact you concerning any change in part number.

Change information, if any, is located at the rear of this manual.

SPECIAL NOTES AND SYMBOLS

X000	Part first added at this serial number
00X	Part removed after this serial number

ITEM NAME

In the Parts List, an Item Name is separated from the description by a colon (:). Because of space limitations, an Item Name may sometimes appear as incomplete. For further Item Name identification, the U.S. Federal Cataloging Handbook H6-1 can be utilized where possible.

ABBREVIATIONS

ACTR	ACTUATOR	PLSTC	PLASTIC
ASSY	ASSEMBLY	QTZ	QUARTZ
CAP	CAPACITOR	RECP	RECEPTACLE
CER	CERAMIC	RES	RESISTOR
CKT	CIRCUIT	RF	RADIO FREQUENCY
COMP	COMPOSITION	SEL	SELECTED
CONN	CONNECTOR	SEMICOND	SEMICONDUCTOR
ELCTLT	ELECTROLYTIC	SENS	SENSITIVE
ELEC	ELECTRICAL	VAR	VARIABLE
INCAND	INCANDESCENT	WW	WIREWOUND
LED	LIGHT EMITTING DIODE	XFMR	TRANSFORMER
NONWIR	NON WIREWOUND	XTAL	CRYSTAL

CROSS INDEX—MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip
00853	SANGAMO ELECTRIC CO., S. CAROLINA DIV.	P O BOX 128	PICKENS, SC 29671
01121	ALLEN-BRADLEY COMPANY	1201 2ND STREET SOUTH	MILWAUKEE, WI 53204
01295	TEXAS INSTRUMENTS, INC., SEMICONDUCTOR GROUP	P O BOX 5012, 13500 N CENTRAL EXPRESSWAY	DALLAS, TX 75222
02735	RCA CORPORATION, SOLID STATE DIVISION	ROUTE 202	SOMERVILLE, NY 08876
04713	MOTOROLA, INC., SEMICONDUCTOR PROD. DIV.	5005 E MCDOWELL RD,PO BOX 20923	PHOENIX, AZ 85036
05397	UNION CARBIDE CORPORATION, MATERIALS SYSTEMS DIVISION	11901 MADISON AVENUE	CLEVELAND, OH 44101
07263	FAIRCHILD SEMICONDUCTOR, A DIV. OF FAIRCHILD CAMERA AND INSTRUMENT CORP.	464 ELLIS STREET	MOUNTAIN VIEW, CA 94042
08806	GENERAL ELECTRIC CO., MINIATURE LAMP PRODUCTS DEPARTMENT	NELA PARK	CLEVELAND, OH 44112
09023	CORNELL-DUBILIER ELECTRONIC DIVISION FEDERAL PACIFIC ELECTRIC CO.	2652 DALRYMPLE ST.	SANFORD, NC 27330
12697	CLAROSTAT MFG. CO., INC.	LOWER WASHINGTON STREET	DOVER, NH 03820
12969	UNITRODE CORPORATION	580 PLEASANT STREET	WATERTOWN, MA 02172
24546	CORNING GLASS WORKS, ELECTRONIC COMPONENTS DIVISION	550 HIGH STREET	BRADFORD, PA 16701
27014	NATIONAL SEMICONDUCTOR CORP.	2900 SEMICONDUCTOR DR.	SANTA CLARA, CA 95051
32159	WEST-CAP ARIZONA	2201 E. ELVIRA ROAD	TUCSON, AZ 85706
32293	INTERSIL, INC.	10900 N. TANTAU AVE.	CUPERTINO, CA 95014
32997	BOURNS, INC., TRIMPOT PRODUCTS DIV.	1200 COLUMBIA AVE.	RIVERSIDE, CA 92507
55292	LEDCO DIV., WILBRECHT ELECTRONICS, INC.	240 EAST PLATO BLVD.	ST. PAUL, MN 55107
55680	NICHICON/AMERICA/CORP.	6435 N PROESEL AVENUE	CHICAGO, IL 60645
56289	SPRAGUE ELECTRIC CO.		NORTH ADAMS, MA 01247
71400	BUSSMAN MFG., DIVISION OF MCGRAW-EDISON CO.	2536 W. UNIVERSITY ST.	ST. LOUIS, MO 63107
72136	ELECTRO MOTIVE CORPORATION, SUB OF INTERNATIONAL ELECTRONICS CORPORATION	LAUTER AVE, P O BOX 7600	FLORENCE, SC 29501
72982	ERIE TECHNOLOGICAL PRODUCTS, INC.	644 W. 12TH ST.	ERIE, PA 16512
73138	BECKMAN INSTRUMENTS, INC., HELIPOT DIV.	2500 HARBOR BLVD.	FULLERTON, CA 92634
74970	JOHNSON, E. F., CO.	299 10TH AVE. S. W.	WASECA, MN 56093
75042	TRW ELECTRONIC COMPONENTS, IRC FIXED RESISTORS, PHILADELPHIA DIVISION	401 N. BROAD ST.	PHILADELPHIA, PA 19108
75378	CTS KNIGHTS, INC.	400 REIMANN AVE.	SANDWICH, IL 60548
78488	STACKPOLE CARBON CO.		ST. MARYS, PA 15857
80009	TEKTRONIX, INC.	P O BOX 500	BEAVERTON, OR 97077
80031	ELECTRA-MIDLAND CORP., MEPCO DIV.	22 COLUMBIA ROAD	MORRISTOWN, NJ 07960
83003	VARO, INC.	P O BOX 411, 2203 WALNUT STREET	GARLAND, TX 75040
90201	MALLORY CAPACITOR CO., DIV. OF P. R. MALLORY AND CO., INC.	3029 E. WASHINGTON STREET P. O. BOX 372	INDIANAPOLIS, IN 46206
91637	DALE ELECTRONICS, INC.	P. O. BOX 609	COLUMBUS, NE 68601

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A1	670-3451-14			CKT BOARD ASSY:DEMODULATOR	80009	670-3451-14
	----- -----			(1420 ONLY)		
A1	670-2451-15			CKT BOARD ASSY:DEMODULATOR	80009	670-2451-15
	----- -----			(1421 ONLY)		
A1	670-3451-16			CKT BOARD ASSY:DEMODULATOR	80009	670-3451-16
	----- -----			(1422 ONLY)		
A2	670-3450-00			CKT BOARD ASSY:DEFLECTTON AMPLIFIER	80009	670-3450-00
A3	670-3134-00			CKT BOARD ASSY:POWER SUPPLY	80009	670-3134-00
A4	670-3676-00			CKT BOARD ASSY:SHIELD	80009	670-3676-00
A5	670-4086-02			CKT BOARD ASSY:EXTERNAL SUBCARRIER	80009	670-4086-02
	----- -----			(1420 ONLY)		
A5	670-4086-03			CKT BOARD ASSY:EXTERNAL SUBCARRIER	80009	670-4086-03
	----- -----			(1421 AND 1422 ONLY)		
C233	283-0638-00			CAP.,FXD,MICA D:130PF,1%,100V	00853	D151F131F0
C235	283-0638-00			CAP.,FXD,MICA D:130PF,1%,100V	00853	D151F131F0
C238	----- -----			(FURNISHED AS A UNIT WITH 119-0647-00.		
	----- -----			1420 AND 1422 ONLY)		
C238	----- -----			(FURNISHED AS A UNIT WITH 119-0648-00.		
	----- -----			1421 ONLY)		
C433	290-0647-00			CAP.,FXD,ELCTLT:10UF,+50-10%,475V	56289	43D100F475GJ4
C1010	283-0618-00			CAP.,FXD,MICA D:130PF,2%,400V	00853	D155E131G0
C1010	----- -----			(1420 AND 1422 ONLY)		
C1010	283-0674-00			CAP.,FXD,MICA D:85PF,1%,500V	00853	D155F850F0
C1010	----- -----			(1421 ONLY)		
C1012	281-0184-00			CAP.,VAR,PLSTC:2-18PF,500VDC	80031	2805D00218BN02F0
C1032	283-0010-00			CAP.,FXD,CER DI:0.05UF,+100-20%,50V	56289	273C20
C1034	281-0168-00			CAP.,VAR,AIR DI:1.3-5.4PF,250V	74970	187-0103-035
C1036	283-0024-00			CAP.,FXD,CER DI:0.1UF,+80-20%,50V	72982	8121N083Z5U0104Z
C1046	283-0024-00			CAP.,FXD,CER DI:0.1UF,+80-20%,50V	72982	8121N083Z5U0104Z
C1074	283-0024-00			CAP.,FXD,CER DI:0.1UF,+80-20%,50V	72982	8121N083Z5U0104Z
C1076	283-0024-00			CAP.,FXD,CER DI:0.1UF,+80-20%,50V	72982	8121N083Z5U0104Z
C1082	283-0010-00			CAP.,FXD,CER DI:0.05UF,+100-20%,50V	56289	273C20
C1084	281-0168-00			CAP.,VAR,AIR DI:1.3-5.4PF,250V	74970	187-0103-035
C1086	283-0024-00			CAP.,FXD,CER DI:0.1UF,+80-20%,50V	72982	8121N083Z5U0104Z
C1116	283-0024-00			CAP.,FXD,CER DI:0.1UF,+80-20%,50V	72982	8121N083Z5U0104Z
C1120	283-0168-00			CAP.,FXD,CER DI:12PF,5%,100V	72982	8101B121C0G0120J
	----- -----			(1420 AND 1422 ONLY)		
C1120	283-0674-00			CAP.,FXD,MICA D:85PF,1%,500V	00853	D155F850F0
	----- -----			(1421 ONLY)		
C1124	283-0024-00			CAP.,FXD,CER DI:0.1UF,+80-20%,50V	72982	8121N083Z5U0104Z
C1136	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	56289	273C5
C1142	283-0024-00			CAP.,FXD,CER DI:0.1UF,+80-20%,50V	72982	8121N083Z5U0104Z
C1148	281-0140-00			CAP.,VAR,CER DI:5-25PF,100V	72982	518-002A5-25
C1160	283-0618-00			CAP.,FXD,MICA D:130PF,2%,400V	00853	D155E131G0
	----- -----			(1420 AND 1422 ONLY)		
C1160	283-0674-00			CAP.,FXD,MICA D:85PF,1%,500V	00853	D155F850F0
	----- -----			(1421 ONLY)		
C1178	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	56289	273C5
C1188	283-0024-00			CAP.,FXD,CER DI:0.1UF,+80-20%,50V	72982	8121N083Z5U0104Z
C1203	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	56289	273C5
	----- -----			(1421 AND 1422 ONLY)		
C1204	283-0024-00			CAP.,FXD,CER DI:0.1UF,+80-20%,50V	72982	8121N083Z5U0104Z
C1205	283-0632-00			CAP.,FXD,MICA D:87PF,1%,100V	00853	D151E870F0
C1206	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
C1214	283-0239-00			CAP.,FXD,CER DI:0.022UF,10%,50V	72982	8121N083X7R0223K
	----- -----			(1421 AND 1422 ONLY)		
C1223	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
	----- -----			(1421 AND 1422 ONLY)		

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
C1233	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
C1235	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
C1237	283-0238-00			CAP.,FXD,CER DI:0.01UF,10%,50V	72982	8121N075X7R0103K
C1242	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	72982	855-558Z5V0203Z
C1243	283-0024-00			CAP.,FXD,CER DI:0.1UF,+80-20%,50V	72982	8121N083Z5U0104Z
C1281	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
C1282	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
	----- -----			(1421 AND 1422 ONLY)		
C1285	283-0024-00			CAP.,FXD,CER DI:0.1UF,+80-20%,50V	72982	8121N083Z5U0104Z
C1286	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
C1287	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
C1291	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
	----- -----			(1421 AND 1422 ONLY)		
C1292	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
C1303	283-0058-00			CAP.,FXD,CER DI:0.027UF,10%,100V	72982	8131N147X7R0273K
	----- -----			(1420 AND 1422 ONLY)		
C1303	283-0268-00			CAP.,FXD,CER DI:0.015UF,10%,50V	72982	8121N083X7R0153K
	----- -----			(1421 ONLY)		
C1314	283-0024-00			CAP.,FXD,CER DI:0.1UF,+80-20%,50V	72982	8121N083Z5U0104Z
C1322	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C1333	283-0239-00			CAP.,FXD,CER DI:0.022UF,10%,50V	72982	8121N083X7R0223K
C1336	283-0024-00			CAP.,FXD,CER DI:0.1UF,+80-20%,50V	72982	8121N083Z5U0104Z
C1337	283-0024-00			CAP.,FXD,CER DI:0.1UF,+80-20%,50V	72982	8121N083Z5U0104Z
C1338	283-0024-00			CAP.,FXD,CER DI:0.1UF,+80-20%,50V	72982	8121N083Z5U0104Z
C1346	283-0655-00			CAP.,FXD,MICA D:0.0033UF,1%,500V	00853	D195F332F0
C1361	290-0527-00			CAP.,FXD,ELCTLT:15UF,20%,20V	90201	TDC156M020FL
C1364	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	72982	855-558Z5V0203Z
C1373	290-0529-00			CAP.,FXD,ELCTLT:47UF,20%,20V	05397	T368C476M020AZ
C1374	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	72982	855-558Z5V0203Z
C1377	290-0536-00			CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
C1383	290-0536-00			CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
C1395	283-0649-00			CAP.,FXD,MICA D:105PF,1%,300V	00853	D153F1050F0
	----- -----			(1420 AND 1422 ONLY)		
C1395	283-0634-00			CAP.,FXD,MICA D:65PF,1%,100V	00853	D151E650F0
	----- -----			(1421 ONLY)		
C1427	283-0024-00			CAP.,FXD,CER DI:0.1UF,+80-20%,50V	72982	8121N083Z5U0104Z
C1428	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C1430	283-0010-00			CAP.,FXD,CER DI:0.05UF,+100-20%,50V	56289	273C20
C1435	283-0010-00			CAP.,FXD,CER DI:0.05UF,+100-20%,50V	56289	273C20
C1444	290-0536-00			CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
C1482	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	72982	855-558Z5V0203Z
C1494	290-0536-00			CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
C1497	283-0024-00			CAP.,FXD,CER DI:0.1UF,+80-20%,50V	72982	8121N083Z5U0104Z
C1505	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C1532	283-0198-00			CAP.,FXD,CER DI:0.22UF,20%,50V	72982	8121N083Z5U0224M
C1533	283-0024-00			CAP.,FXD,CER DI:0.1UF,+80-20%,50V	72982	8121N083Z5U0104Z
C1553	283-0024-00			CAP.,FXD,CER DI:0.1UF,+80-20%,50V	72982	8121N083Z5U0104Z
C1555	283-0198-00			CAP.,FXD,CER DI:0.22UF,20%,50V	72982	8121N083Z5U0224M
C1564	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C1566	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C1571	283-0691-00			CAP.,FXD,MICA D:650PF,1%,300V	00853	D153F651F0
C1587	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C1592	283-0598-00			CAP.,FXD,MICA D:253PF,5%,300V	00853	D153E2530J0
C1646	283-0691-00			CAP.,FXD,MICA D:650PF,1%,300V	00853	D153F651F0
	----- -----			(1420 AND 1422 ONLY)		
C1646	283-0660-00			CAP.,FXD,MICA D:510PF,2%,500V	00853	D155F511G0
	----- -----			(1421 ONLY)		

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C1647	283-0104-00			CAP.,FXD,CER DI:2000PF,5%,500V	72982	811-565B202J
C1653	283-0660-00			CAP.,FXD,MICA D:510PF,2%,500V	00853	D155F511G0
	----- -----			(1420 AND 1422 ONLY)		
C1653	283-0698-00			CAP.,FXD,MICA D:390PF,1%,500V	09023	CD15ED391F03
	----- -----			(1421 ONLY)		
C1662	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C1671	283-0024-00			CAP.,FXD,CER DI:0.1UF,+80-20%,50V	72982	8121N083Z5U0104Z
C1675	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
	----- -----			(1421 AND 1422 ONLY)		
C1685	283-0597-00			CAP.,FXD,MICA D:470PF,10%,300V	00853	D153E471K0
C1690	283-0655-00			CAP.,FXD,MICA D:0.0033UF,1%,500V	00853	D195F332F0
C1699	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C1701	283-0024-00			CAP.,FXD,CER DI:0.1UF,+80-20%,50V	72982	8121N083Z5U0104Z
C1720	283-0024-00			CAP.,FXD,CER DI:0.1UF,+80-20%,50V	72982	8121N083Z5U0104Z
C1731	283-0618-00			CAP.,FXD,MICA D:130PF,2%,400V	00853	D155E131G0
	----- -----			(1420 AND 1422 ONLY)		
C1731	283-0674-00			CAP.,FXD,MICA D:85PF,1%,500V	00853	D155F850F0
	----- -----			(1421 ONLY)		
C1744	283-0024-00			CAP.,FXD,CER DI:0.1UF,+80-20%,50V	72982	8121N083Z5U0104Z
C1784	283-0024-00			CAP.,FXD,CER DI:0.1UF,+80-20%,50V	72982	8121N083Z5U0104Z
C1788	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C1829	283-0647-00			CAP.,FXD,MICA D:70PF,1%,100V	00853	D151E700F0
C1830	283-0605-00			CAP.,FXD,MICA D:678PF,1%,300V	00853	D153F6780F0
C1831	283-0680-00			CAP.,FXD,MICA D:330PF,1%,500V	72136	DM15ED331F0
C1835	283-0605-00			CAP.,FXD,MICA D:678PF,1%,300V	00853	D153F6780F0
C1836	283-0680-00			CAP.,FXD,MICA D:330PF,1%,500V	72136	DM15ED331F0
C1850	283-0647-00			CAP.,FXD,MICA D:70PF,1%,100V	00853	D151E700F0
C1865	281-0504-00			CAP.,FXD,CER DI:10PF,+/-1PF,500V	72982	301-055C0G0100F
C1888	290-0527-00			CAP.,FXD,ELCTLT:15UF,20%,20V	90201	TDC156M020FL
C1890	290-0145-00			CAP.,FXD,ELCTLT:10UF,+75-10%,50V	56289	30D106G050CB9
C1902	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C1910	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	56289	273C5
C1951	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	56289	273C5
C1962	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C1970	283-0594-00			CAP.,FXD,MICA D:0.001UF,1%,100V	00853	D151F102F0
C1972	283-0598-00			CAP.,FXD,MICA D:253PF,5%,300V	00853	D153E253GJ0
C1981	283-0024-00			CAP.,FXD,CER DI:0.1UF,+80-20%,50V	72982	8121N083Z5U0104Z
C1982	283-0024-00			CAP.,FXD,CER DI:0.1UF,+80-20%,50V	72982	8121N083Z5U0104Z
C2065	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
C2835	283-0641-00			CAP.,FXD,MICA D:180PF,1%,100V	00853	D151E181F0
C2890	283-0631-00			CAP.,FXD,MICA D:95PF,1%,100V	00853	D151E950F0
C2891	281-0097-00			CAP.,VAR,CER DI:9-35PF,200V	72982	538-006-D9-35
C3110	283-0010-00			CAP.,FXD,CER DI:0.05UF,+100-20%,50V	56289	273C20
C3112	290-0804-00			CAP.,FXD,ELCTLT:10UF,+50-10%,25V	55680	25ULA10V-T
C3130	290-0644-00			CAP.,FXD,ELCTLT:1400UF,+75-10%,30V	00853	066HL1424030B
C3150	290-0644-00			CAP.,FXD,ELCTLT:1400UF,+75-10%,30V	00853	066HL1424030B
C3189	283-0010-00			CAP.,FXD,CER DI:0.05UF,+100-20%,50V	56289	273C20
C3220	290-0274-00			CAP.,FXD,ELCTLT:80UF,+75-10%,50V	56289	600D806G050DJ4
C3275	283-0267-00			CAP.,FXD,CER DI:0.01UF,20%,500V	72982	0841546Y5500103M
C3289	290-0804-00			CAP.,FXD,ELCTLT:10UF,+50-10%,25V	55680	25ULA10V-T
C3350	283-0531-00			CAP.,FXD,MICA D:0.0039UF,5%,500V	09023	CD19FD392J03
C3395	283-0684-00			CAP.,FXD,MICA D:620PF,20%,300V	00853	D153E621G0
C3412	290-0167-00			CAP.,FXD,ELCTLT:10UF,20%,15V	56289	150D106X0015B2
C3440	290-0117-00			CAP.,FXD,ELCTLT:50UF,+75-10%,50V	56289	30D506G050DD9
C3453	283-0187-00			CAP.,FXD,CER DI:0.047UF,10%,400V	72982	8131N401X5R0473K
C3459	283-0187-00			CAP.,FXD,CER DI:0.047UF,10%,400V	72982	8131N401X5R0473K

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C3730	285-0509-01			CAP.,FXD,PLSTC:0.0068UF,20%,5000V	56289	430P507
C3731	285-0509-01			CAP.,FXD,PLSTC:0.0068UF,20%,5000V	56289	430P507
C3780	283-0006-00			CAP.,FXD,CER DI:0.02UF,+80-20%,500V	72982	0841545Z5V00203Z
CR1110	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR1122	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR1148	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR1164	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR1168	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR1204	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR1225	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR1233	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR1235	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR1244	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR1255	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR1304	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR1329	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR1335	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR1362	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR1401	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR1413	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR1434	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR1483	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR1484	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR1535	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR1552	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR1663	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR1671	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR1876	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR3009	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR3010	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR3050	152-0488-00			SEMICOND DEVICE:SILICON,200V,1500MA	04713	3N55 FAMILY
CR3070	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR3075	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR3180	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR3308	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR3380	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR3408	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR3545	152-0413-00			SEMICOND DEVICE:SILICON,400V,750MA	12969	UTR307
CR3750	152-0408-00			SEMICOND DEVICE:SILICON,10KV,5MA	83003	H345
CR3925	152-0107-00			SEMICOND DEVICE:SILICON,400V,400MA	01295	G727
CR3930	152-0107-00			SEMICOND DEVICE:SILICON,400V,400MA	01295	G727
CR3935	152-0107-00			SEMICOND DEVICE:SILICON,400V,400MA	01295	G727
CR3939	152-0107-00			SEMICOND DEVICE:SILICON,400V,400MA	01295	G727
DS210	150-0123-03			LAMP,CARTRIDGE:14V,23MA	55292	71523-02
DS211	150-0123-01			LAMP,CARTRIDGE:14V,0.023A,YELLOW LENS	55292	71326-06
DS590	150-0059-00			LAMP,INCAND:14V,0.08A	08806	386
DS592	150-0059-00			LAMP,INCAND:14V,0.08A	08806	386
F490	159-0042-00			FUSE,CARTRIDGE:3AG,0.75A,250V,FAST-BLOW	71400	AGC 3/4
	----- -----			(FOR 110V ONLY)		
F490	159-0025-00			FUSE,CARTRIDGE:3AG,0.5A,250V,FAST-BLOW	71400	AGC 1/2
	----- -----			(FOR 220V ONLY)		
L290	276-0569-00			CORE,TOROID:	80009	276-0569-00
L292	276-0569-00			CORE,TOROID:	80009	276-0569-00
L294	276-0573-00			CORE,EM:TOROID FERRITE	78488	57-0972
L295	276-0573-00			CORE,EM:TOROID FERRITE	78488	57-0972
L1118	114-0303-00			COIL,RF:6.5-23UH,CORE 276-0506-00	80009	114-0303-00

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L1178	114-0303-00			COIL,RF:6.5-23UH,CORE 276-0506-00	80009	114-0303-00
L1204	114-0332-00			COIL,RF:VARIABLE,12-20UH	80009	114-0332-00
L1290	108-0317-00			COIL,RF:FIXED,15UH	32159	71501M
L1305	114-0339-00			COIL,RF:40-80UH	80009	114-0339-00
L1636	108-0317-00			COIL,RF:FIXED,15UH	32159	71501M
L1666	114-0222-00			COIL,RF:2-6UH,CORE 276-0568-00	80009	114-0222-00
L1770	108-0317-00			COIL,RF:FIXED,15UH	32159	71501M
L1821	114-0311-00			COIL,RF:65-190UH,CORE 276-0568-00	80009	114-0311-00
L1827	114-0310-00			COIL,RF:22-80UH	80009	114-0310-00
L1841	114-0311-00			COIL,RF:65-190UH,CORE 276-0568-00	80009	114-0311-00
L1847	114-0310-00			COIL,RF:22-80UH	80009	114-0310-00
L3430	108-0473-00			COIL,RF:150UH	80009	108-0473-00
Q425	151-0405-00			TRANSISTOR:SILICON,NPN,SEL FROM MJE800	80009	151-0405-00
Q427	151-0429-00			TRANSISTOR:SILICON,PND	80009	151-0429-00
Q428	151-0423-00			TRANSISTOR:SILICON,NPN	01295	EP2970
Q430	151-0140-00			TRANSISTOR:SILICON,NPN	80009	151-0140-00
Q590	151-0462-00			TRANSISTOR:SILICON,PNP	80009	151-0462-00
Q1032	151-1005-00			TRANSISTOR:SILICON,JFE,N-CHANNEL	80009	151-1005-00
Q1034	151-0438-00			TRANSISTOR:SILICON,PNP,SEL FROM SPS6927	80009	151-0438-00
Q1036	151-0195-00			TRANSISTOR:SILICON,NPN	80009	151-0195-00
Q1082	151-1005-00			TRANSISTOR:SILICON,JFE,N-CHANNEL	80009	151-1005-00
Q1084	151-0438-00			TRANSISTOR:SILICON,PNP,SEL FROM SPS6927	80009	151-0438-00
Q1086	151-0195-00			TRANSISTOR:SILICON,NPN	80009	151-0195-00
Q1110	151-0207-00			TRANSISTOR:SILICON,NPN	80009	151-0207-00
Q1120	151-0207-00			TRANSISTOR:SILICON,NPN	80009	151-0207-00
Q1140	151-0207-00			TRANSISTOR:SILICON,NPN	80009	151-0207-00
Q1160	151-0207-00			TRANSISTOR:SILICON,NPN	80009	151-0207-00
Q1180	151-0207-00			TRANSISTOR:SILICON,NPN	80009	151-0207-00
Q1201	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
Q1202	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
	----- -----			(1421 AND 1422 ONLY)		
Q1205	151-0220-00			TRANSISTOR:SILICON,PNP	07263	S036228
Q1209	151-0220-00			TRANSISTOR:SILICON,PNP	07263	S036228
	----- -----			(1421 AND 1422 ONLY)		
Q1215	151-0220-00			TRANSISTOR:SILICON,PNP	07263	S036228
Q1222	151-0223-00			TRANSISTOR:SILICON,NPN	04713	SPS8026
Q1223	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	04713	SPS8801
	----- -----			(1421 AND 1422 ONLY)		
Q1225	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
Q1227	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	04713	SPS8801
Q1233	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	04713	SPS8801
Q1234	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	04713	SPS8801
	----- -----			(1421 AND 1422 ONLY)		
Q1235	151-0333-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS918	04713	SPS1752
Q1249	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	04713	SPS8801
	----- -----			(1421 AND 1422 ONLY)		
Q1253	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	04713	SPS8801
Q1318	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	04713	SPS8801
Q1332	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	04713	SPS8801
Q1342	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
Q1345	151-0223-00			TRANSISTOR:SILICON,NPN	04713	SPS8026
Q1348	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
Q1355	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
Q1359	151-0164-00			TRANSISTOR:SILICON,PNP	01295	SKB3334
Q1362	151-0410-00			TRANSISTOR:SILICON,PNP	80009	151-0410-00
Q1364	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	04713	SPS8801
Q1372	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
Q1397	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	04713	SPS8801
Q1398	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	04713	SPS8801
Q1410	151-0325-00			TRANSISTOR:SILICON,PNP,SEL FROM 2N4258	80009	151-0325-00
Q1412	151-0195-00			TRANSISTOR:SILICON,NPN	80009	151-0195-00
Q1432	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	04713	SPS8801
Q1433	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	04713	SPS8801
Q1462	151-0103-00			TRANSISTOR:SILICON,NPN	80009	151-0103-00
Q1472	151-0236-00			TRANSISTOR:SILICON,NPN	32293	ITS1074
Q1476	151-0223-00			TRANSISTOR:SILICON,NPN	04713	SPS8026
Q1477	151-0223-00			TRANSISTOR:SILICON,NPN	04713	SPS8026
Q1502	151-0195-00			TRANSISTOR:SILICON,NPN	80009	151-0195-00
Q1512	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
Q1513	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	04713	SPS8801
	----- -----			(1421 AND 1422 ONLY)		
Q1528	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	04713	SPS8801
Q1531	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	04713	SPS8801
	----- -----			(1421 AND 1422 ONLY)		
Q1543	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	04713	SPS8801
Q1570	151-0223-00			TRANSISTOR:SILICON,NPN	04713	SPS8026
Q1573	151-0325-00			TRANSISTOR:SILICON,PNP,SEL FROM 2N4258	80009	151-0325-00
Q1579	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	04713	SPS8801
Q1584	151-0325-00			TRANSISTOR:SILICON,PNP,SEL FROM 2N4258	80009	151-0325-00
Q1595	151-0223-00			TRANSISTOR:SILICON,NPN	04713	SPS8026
Q1605	151-0223-00			TRANSISTOR:SILICON,NPN	04713	SPS8026
Q1680	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	04713	SPS8801
Q1718	151-0223-00			TRANSISTOR:SILICON,NPN	04713	SPS8026
Q1739	151-0223-00			TRANSISTOR:SILICON,NPN	04713	SPS8026
Q1781	151-0410-00			TRANSISTOR:SILICON,PNP	80009	151-0410-00
Q1782	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	04713	SPS8801
Q1801	151-0301-00			TRANSISTOR:SILICON,PNP	04713	2N2907A
	----- -----			(1420 AND 1422 ONLY)		
Q1811	151-1005-00			TRANSISTOR:SILICON,JFE,N-CHANNEL	80009	151-1005-00
Q1855	151-1005-00			TRANSISTOR:SILICON,JFE,N-CHANNEL	80009	151-1005-00
Q1865	151-0325-00			TRANSISTOR:SILICON,PNP,SEL FROM 2N4258	80009	151-0325-00
Q1927	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	04713	SPS8801
Q1928	151-0220-00			TRANSISTOR:SILICON,PNP	07263	S036228
Q1929	151-0195-00			TRANSISTOR:SILICON,NPN	80009	151-0195-00
Q1933	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	04713	SPS8801
Q1935	151-0220-00			TRANSISTOR:SILICON,PNP	07263	S036228
Q1937	151-0195-00			TRANSISTOR:SILICON,NPN	80009	151-0195-00
Q1963	151-0223-00			TRANSISTOR:SILICON,NPN	04713	SPS8026
Q1973	151-0223-00			TRANSISTOR:SILICON,NPN	04713	SPS8026
Q1995	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
Q2655	151-0232-00			TRANSISTOR:SILICON,NPN,DUAL	80009	151-0232-00
Q2700	151-0279-00			TRANSISTOR:SILICON,NPN	80009	151-0279-00
Q2735	151-0279-00			TRANSISTOR:SILICON,NPN	80009	151-0279-00
Q2775	151-0279-00			TRANSISTOR:SILICON,NPN	80009	151-0279-00
Q2795	151-0279-00			TRANSISTOR:SILICON,NPN	80009	151-0279-00
Q3018	151-0410-00			TRANSISTOR:SILICON,PNP	80009	151-0410-00
Q3019	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	04713	SPS8801
Q3080	151-0410-00			TRANSISTOR:SILICON,PNP	80009	151-0410-00
Q3088	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	04713	SPS8801
Q3279	151-0410-00			TRANSISTOR:SILICON,PNP	80009	151-0410-00
Q3380	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	04713	SPS8801
Q3905	151-0280-00			TRANSISTOR:SILICON,PNP	04713	SS8065
R211	315-0361-00			RES.,FXD,CMPSN:360 OHM,5%,0.25W	01121	CB3615
R222	311-1678-00			RES.,VAR,NONWIR:5K OHM,20%,1W	01121	12M267

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R224	315-0561-00			RES.,FXD,CMPSN:560 OHM,5%,0.25W	01121	CB5615
R234	321-0144-00			RES.,FXD,FILM:309 OHM,1%,0.125W	91637	MFF1816G309R0F
R238	----- -----			(FURNISHED AS A UNIT WITH 119-0647-00.		
	----- -----			1420 AND 1422 ONLY)		
R238	----- -----			(FURNISHED AS A UNIT WITH 119-0648-00.		
	----- -----			1421 ONLY)		
R410	311-1690-00			RES.,VAR,NONWIR:2M OHM,20%,1W	12697	381-CM40391
R420	311-1691-00			RES.,VAR,NONWIR:5M OHM,20%,1W	12697	381-CM40392
R430	311-1689-00			RES.,VAR,NONWIR:50K OHM,20%,0.50W	01121	W8238
R440	311-1689-00			RES.,VAR,NONWIR:50K OHM,20%,0.50W	01121	W8238
R445	311-0771-00			RES.,VAR,NONWIR:PNL,1K OHM,0.5W/SW	12697	381-CM39686
R491	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1012	321-0210-00			RES.,FXD,FILM:1.5K OHM,1%,0.125W	91637	MFF1816G15000F
R1020	321-0171-00			RES.,FXD,FILM:590 OHM,1%,0.125W	91637	MFF1816G590R0F
R1022	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R1024	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1028	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R1030	321-0481-00			RES.,FXD,FILM:1M OHM,1%,0.125W	24546	NA4D1004F
R1032	321-0481-00			RES.,FXD,FILM:1M OHM,1%,0.125W	24546	NA4D1004F
R1041	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R1044	321-0222-00			RES.,FXD,FILM:2K OHM,1%,0.125W	91637	MFF1816G20000F
R1048	321-0222-00			RES.,FXD,FILM:2K OHM,1%,0.125W	91637	MFF1816G20000F
R1056	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R1062	321-0171-00			RES.,FXD,FILM:590 OHM,1%,0.125W	91637	MFF1816G590R0F
R1064	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R1068	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R1070	321-0481-00			RES.,FXD,FILM:1M OHM,1%,0.125W	24546	NA4D1004F
R1072	321-0481-00			RES.,FXD,FILM:1M OHM,1%,0.125W	24546	NA4D1004F
R1074	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1078	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1084	321-0222-00			RES.,FXD,FILM:2K OHM,1%,0.125W	91637	MFF1816G20000F
R1092	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R1094	321-0222-00			RES.,FXD,FILM:2K OHM,1%,0.125W	91637	MFF1816G20000F
R1096	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R1110	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1112	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R1122	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1124	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R1134	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1144	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1146	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R1174	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1176	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R1186	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1188	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R1201	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R1202	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R1203	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
	----- -----			(1421 AND 1422 ONLY)		
R1204	315-0361-00			RES.,FXD,CMPSN:360 OHM,5%,0.25W	01121	CB3615
R1205	315-0133-00			RES.,FXD,CMPSN:13K OHM,5%,0.25W	01121	CB1335
	----- -----			(1421 AND 1422 ONLY)		
R1206	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
	----- -----			(1421 AND 1422 ONLY)		
R1207	315-0622-00			RES.,FXD,CMPSN:6.2K OHM,5%,0.25W	01121	CB6225
	----- -----			(1421 AND 1422 ONLY)		
R1208	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R1209	315-0220-00			RES.,FXD,CMPSN:22 OHM,5%,0.25W	01121	CB2205
	----- -----			(1421 AND 1422 ONLY)		
R1210	315-0303-00			RES.,FXD,CMPSN:30K OHM,5%,0.25W	01121	CB3035
R1213	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1214	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
	----- -----			(1421 AND 1422 ONLY)		
R1216	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R1218	321-0232-00			RES.,FXD,FILM:2.55K OHM,1%,0.125W	91637	MFF1816G25500F
R1219	315-0244-00			RES.,FXD,CMPSN:240K OHM,5%,0.25W	01121	CB2445
	----- -----			(1421 AND 1422 ONLY)		
R1221	315-0242-00			RES.,FXD,CMPSN:2.4K OHM,5%,0.25W	01121	CB2425
R1223	315-0122-00			RES.,FXD,CMPSN:1.2K OHM,5%,0.25W	01121	CB1225
	----- -----			(1421 AND 1422 ONLY)		
R1226	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R1229	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
	----- -----			(1421 AND 1422 ONLY)		
R1231	315-0750-00			RES.,FXD,CMPSN:75 OHM,5%,0.25W	01121	CB7505
R1232	315-0623-00			RES.,FXD,CMPSN:62K OHM,5%,0.25W	01121	CB6235
R1233	315-0821-00			RES.,FXD,CMPSN:820 OHM,5%,0.25W	01121	CB8215
	----- -----			(1421 AND 1422 ONLY)		
R1237	315-0475-00			RES.,FXD,CMPSN:4.7M OHM,5%,0.25W	01121	CB4755
R1240	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R1241	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R1246	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R1248	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R1249	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
	----- -----			(1421 AND 1422 ONLY)		
R1255	315-0113-00			RES.,FXD,CMPSN:11K OHM,5%,0.25W	01121	CB1135
R1256	315-0393-00			RES.,FXD,CMPSN:39K OHM,5%,0.25W	01121	CB3935
R1264	315-0914-00			RES.,FXD,CMPSN:910K OHM,5%,0.25W	01121	CB9145
R1266	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1268	315-0301-00			RES.,FXD,CMPSN:300 OHM,5%,0.25W	01121	CB3015
R1276	315-0361-00			RES.,FXD,CMPSN:360 OHM,5%,0.25W	01121	CB3615
R1281	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R1284	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R1286	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
	----- -----			(1421 AND 1422 ONLY)		
R1305	321-0323-00			RES.,FXD,FILM:22.6K OHM,1%,0.125W	91637	MFF1816G22601F
R1311	315-0303-00			RES.,FXD,CMPSN:30K OHM,5%,0.25W	01121	CB3035
R1312	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R1315	315-0562-00			RES.,FXD,CMPSN:5.6K OHM,5%,0.25W	01121	CB5625
R1317	315-0123-00			RES.,FXD,CMPSN:12K OHM,5%,0.25W	01121	CB1235
R1326	315-0201-00			RES.,FXD,CMPSN:200 OHM,5%,0.25W	01121	CB2015
R1327	321-0929-07			RES.,FXD,FILM:2.5K OHM,0.10%,0.125W	91637	MFF1816C25000B
R1328	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R1331	315-0302-00			RES.,FXD,CMPSN:3K OHM,5%,0.25W	01121	CB3025
R1337	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R1339	321-0705-00			RES.,FXD,FILM:41.7K OHM,1%,0.125W	91637	MFF1816G41701F
R1345	315-0361-00			RES.,FXD,CMPSN:360 OHM,5%,0.25W	01121	CB3615
R1346	321-0268-00			RES.,FXD,FILM:6.04K OHM,1%,0.125W	91637	MFF1816G60400F
R1348	315-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
R1355	315-0561-00			RES.,FXD,CMPSN:560 OHM,5%,0.25W	01121	CB5615
R1357	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R1366	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R1368	315-0362-00			RES.,FXD,CMPSN:3.6K OHM,5%,0.25W	01121	CB3625
R1369	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R1370	315-0241-00			RES.,FXD,CMPSN:240 OHM,5%,0.25W	01121	CB2415

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R1373	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R1375	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R1386	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R1387	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R1389	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1390	315-0752-00			RES.,FXD,CMPSN:7.5K OHM,5%,0.25W	01121	CB7525
R1405	321-0205-00			RES.,FXD,FILM:1.33K OHM,1%,0.125W	91637	MFF1816G13300F
R1407	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R1415	321-0272-00			RES.,FXD,FILM:6.65K OHM,1%,0.125W	91637	MFF1816G66500F
	----- -----			(1420 AND 1422 ONLY)		
R1415	321-0266-00			RES.,FXD,FILM:5.76K OHM,1%,0.125W	91637	MFF1816G57600F
	----- -----			(1421 ONLY)		
R1417	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R1425	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1429	315-0302-00			RES.,FXD,CMPSN:3K OHM,5%,0.25W	01121	CB3025
R1436	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825
	----- -----			(1421 AND 1422 ONLY)		
R1437	315-0242-00			RES.,FXD,CMPSN:2.4K OHM,5%,0.25W	01121	CB2425
	----- -----			(1421 AND 1422 ONLY)		
R1438	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
	----- -----			(1421 AND 1422 ONLY)		
R1442	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R1443	315-0753-00			RES.,FXD,CMPSN:75K OHM,5%,0.25W	01121	CB7535
R1445	315-0122-00			RES.,FXD,CMPSN:1.2K OHM,5%,0.25W	01121	CB1225
R1450	315-0241-00			RES.,FXD,CMPSN:240 OHM,5%,0.25W	01121	CB2415
R1458	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R1464	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R1473	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R1482	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R1483	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R1484	315-0752-00			RES.,FXD,CMPSN:7.5K OHM,5%,0.25W	01121	CB7525
R1485	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R1493	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1495	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R1496	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R1503	315-0681-00			RES.,FXD,CMPSN:680 OHM,5%,0.25W	01121	CB6815
R1505	315-0361-00			RES.,FXD,CMPSN:360 OHM,5%,0.25W	01121	CB3615
R1507	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R1510	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R1518	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R1523	315-0821-00			RES.,FXD,CMPSN:820 OHM,5%,0.25W	01121	CB8215
	----- -----			(1421 AND 1422 ONLY)		
R1525	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R1550	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R1551	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1553	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R1554	311-1272-00			RES.,VAR,NONWIR:100K OHM,10%,0.50W	32997	3329P-L58-104
R1555	315-0753-00			RES.,FXD,CMPSN:75K OHM,5%,0.25W	01121	CB7535
R1560	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R1561	311-0614-00			RES.,VAR,NONWIR:30K OHM,10%,0.20W	73138	82-28-0
R1562	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R1563	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1564	315-0273-00			RES.,FXD,CMPSN:27K OHM,5%,0.25W	01121	CB2735
R1565	321-0277-00			RES.,FXD,FILM:7.5K OHM,1%,0.125W	91637	MFF1816G75000F
R1568	315-0474-00			RES.,FXD,CMPSN:470K OHM,5%,0.25W	01121	CB4745
R1572	315-0302-00			RES.,FXD,CMPSN:3K OHM,5%,0.25W	01121	CB3025
R1575	315-0822-00			RES.,FXD,CMPSN:8.2K OHM,5%,0.25W	01121	CB8225

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R1576	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R1577	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R1582	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R1583	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R1586	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R1588	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R1594	315-0302-00			RES.,FXD,CMPSN:3K OHM,5%,0.25W	01121	CB3025
R1602	321-0093-00			RES.,FXD,FILM:90.9 OHM,1%,0.125W	91637	MFF1816G90R90F
R1603	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1612	321-0093-00			RES.,FXD,FILM:90.9 OHM,1%,0.125W	91637	MFF1816G90R90F
R1615	315-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.25W	01121	CB3315
R1616	315-0112-00			RES.,FXD,CMPSN:1.1K OHM,5%,0.25W	01121	CB1125
R1622	315-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.25W	01121	CB3315
R1623	315-0112-00			RES.,FXD,CMPSN:1.1K OHM,5%,0.25W	01121	CB1125
R1625	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R1635	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R1645	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R1652	311-1272-00			RES.,VAR,NONWIR:100K OHM,10%,0.50W	32997	3329P-L58-104
R1653	315-0391-00			RES.,FXD,CMPSN:390 OHM,5%,0.25W	01121	CB3915
R1675	315-0333-00			RES.,FXD,CMPSN:33K OHM,5%,0.25W	01121	CB3335
R1679	315-0273-00			RES.,FXD,CMPSN:27K OHM,5%,0.25W	01121	CB2735
R1680	315-0273-00			RES.,FXD,CMPSN:27K OHM,5%,0.25W	01121	CB2735
R1685	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R1688	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R1689	315-0752-00			RES.,FXD,CMPSN:7.5K OHM,5%,0.25W	01121	CB7525
R1701	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R1702	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R1709	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R1717	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R1720	321-0164-00			RES.,FXD,FILM:499 OHM,1%,0.125W	91637	MFF1816G499R0F
R1724	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R1728	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R1730	315-0822-00			RES.,FXD,CMPSN:8.2K OHM,5%,0.25W	01121	CB8225
R1735	321-0164-00			RES.,FXD,FILM:499 OHM,1%,0.125W	91637	MFF1816G499R0F
R1739	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R1740	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R1744	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
R1745	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R1746	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R1747	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R1755	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R1759	311-0622-00			RES.,VAR,NONWIR:100 OHM,10%,0.50W	32997	3326H-G48-101
R1760	321-0164-00			RES.,FXD,FILM:499 OHM,1%,0.125W	91637	MFF1816G499R0F
R1776	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1777	315-0203-00			RES.,FXD,CMPSN:20K OHM,5%,0.25W	01121	CB2035
R1781	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R1783	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R1800	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R1826	315-0753-00			RES.,FXD,CMPSN:75K OHM,5%,0.25W	01121	CB7535
R1831	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R1837	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R1839	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R1865	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
R1870	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R1876	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R1902	315-0123-00			RES.,FXD,CMPSN:12K OHM,5%,0.25W	01121	CB1235
R1910	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025

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R1912	321-0277-00			RES.,FXD,FILM:7.5K OHM,1%,0.125W	91637	MFF1816G75000F
R1916	311-0607-00			RES.,VAR,NONWIR:10K OHM,10%,0.50W	73138	82P-59-4-103K
R1920	321-0164-00			RES.,FXD,FILM:499 OHM,1%,0.125W	91637	MFF1816G499R0F
R1921	315-0392-00			RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	01121	CB3925
R1923	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R1924	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1925	315-0561-00			RES.,FXD,CMPSN:560 OHM,5%,0.25W	01121	CB5615
R1934	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1940	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R1942	321-0164-00			RES.,FXD,FILM:499 OHM,1%,0.125W	91637	MFF1816G499R0F
R1944	321-0277-00			RES.,FXD,FILM:7.5K OHM,1%,0.125W	91637	MFF1816G75000F
R1946	315-0753-00			RES.,FXD,CMPSN:75K OHM,5%,0.25W	01121	CB7535
R1947	315-0392-00			RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	01121	CB3925
R1948	315-0561-00			RES.,FXD,CMPSN:560 OHM,5%,0.25W	01121	CB5615
R1951	311-0607-00			RES.,VAR,NONWIR:10K OHM,10%,0.50W	73138	82P-59-4-103K
R1960	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R1962	315-0123-00			RES.,FXD,CMPSN:12K OHM,5%,0.25W	01121	CB1235
R1963	321-0243-00			RES.,FXD,FILM:3.32K OHM,1%,0.125W	91637	MFF1816G33200F
R1965	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R1967	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R1969	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R1974	321-0273-00			RES.,FXD,FILM:6.81K OHM,1%,0.125W	91637	MFF1816G68100F
R1977	321-0361-00			RES.,FXD,FILM:56.2K OHM,1%,0.125W	91637	MFF1816G56201F
R1985	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R1986	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
R2000	308-0241-00			RES.,FXD,WW:22K OHM,1%,7W	91637	RS5-B22001F
R2020	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R2035	308-0241-00			RES.,FXD,WW:22K OHM,1%,7W	91637	RS5-B22001F
R2070	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R2075	308-0241-00			RES.,FXD,WW:22K OHM,1%,7W	91637	RS5-B22001F
R2095	308-0241-00			RES.,FXD,WW:22K OHM,1%,7W	91637	RS5-B22001F
R2230	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R2250	321-0297-00			RES.,FXD,FILM:12.1K OHM,1%,0.125W	91637	MFF1816G12101F
R2256	321-0239-00			RES.,FXD,FILM:3.01K OHM,1%,0.125W	91637	MFF1816G30100F
R2290	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R2520	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R2535	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R2540	321-0131-00			RES.,FXD,FILM:226 OHM,1%,0.125W	91637	MFF1816G226R0F
R2560	321-0131-00			RES.,FXD,FILM:226 OHM,1%,0.125W	91637	MFF1816G226R0F
R2590	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R2595	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R2615	321-0179-00			RES.,FXD,FILM:715 OHM,1%,0.125W	91637	MFF1816G715R0F
R2630	321-0179-00			RES.,FXD,FILM:715 OHM,1%,0.125W	91637	MFF1816G715R0F
R2685	321-0179-00			RES.,FXD,FILM:715 OHM,1%,0.125W	91637	MFF1816G715R0F
R2692	321-0179-00			RES.,FXD,FILM:715 OHM,1%,0.125W	91637	MFF1816G715R0F
R2720	315-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.25W	01121	CB3315
R2780	315-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.25W	01121	CB3315
R3008	315-0301-00			RES.,FXD,CMPSN:300 OHM,5%,0.25W	01121	CB3015
R3019	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R3079	315-0303-00			RES.,FXD,CMPSN:30K OHM,5%,0.25W	01121	CB3035
R3090	315-0301-00			RES.,FXD,CMPSN:300 OHM,5%,0.25W	01121	CB3015
R3100	321-0250-00			RES.,FXD,FILM:3.92K OHM,1%,0.125W	91637	MFF1816G39200F
R3115	311-1224-00			RES.,VAR,NONWIR:500 OHM,20%,0.50W	32997	3386F-T04-501
R3122	321-0243-00			RES.,FXD,FILM:3.32K OHM,1%,0.125W	91637	MFF1816G33200F
R3170	315-0392-00			RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	01121	CB3925
R3182	321-0251-00			RES.,FXD,FILM:4.02K OHM,1%,0.125W	91637	MFF1816G40200F
R3186	321-0251-00			RES.,FXD,FILM:4.02K OHM,1%,0.125W	91637	MFF1816G40200F

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R3210	315-0112-00			RES.,FXD,CMPSN:1.1K OHM,5%,0.25W	01121	CB1125
R3276	315-0243-00			RES.,FXD,CMPSN:24K OHM,5%,0.25W	01121	CB2435
R3280	323-0414-00			RES.,FXD,FILM:200K OHM,1%,0.50W	75042	CECTO-2003F
R3288	321-0308-00			RES.,FXD,FILM:15.8K OHM,1%,0.125W	91637	MFF1816G15801F
R3309	315-0822-00			RES.,FXD,CMPSN:8.2K OHM,5%,0.25W	01121	CB8225
R3310	308-0245-00			RES.,FXD,WW:0.6 OHM,5%,2W	91637	CW-2B30.60HM 5%
R3369	315-0392-00			RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	01121	CB3925
R3375	315-0123-00			RES.,FXD,CMPSN:12K OHM,5%,0.25W	01121	CB1235
R3379	315-0393-00			RES.,FXD,CMPSN:39K OHM,5%,0.25W	01121	CB3935
R3388	308-0245-00			RES.,FXD,WW:0.6 OHM,5%,2W	91637	CW-2B30.60HM 5%
R3455	315-0511-00			RES.,FXD,CMPSN:510 OHM,5%,0.25W	01121	CB5115
R3468	311-1252-00			RES.,VAR,NONWIR:500K OHM,20%,0.50W	32997	3386F-T04-504
R3475	315-0154-00			RES.,FXD,CMPSN:150K OHM,5%,0.25W	01121	CB1545
R3480	315-0154-00			RES.,FXD,CMPSN:150K OHM,5%,0.25W	01121	CB1545
R3550	305-0755-00			RES.,FXD,CMPSN:7.5M OHM,5%,2W	01121	HB7555
R3570	305-0755-00			RES.,FXD,CMPSN:7.5M OHM,5%,2W	01121	HB7555
R3580	305-0755-00			RES.,FXD,CMPSN:7.5M OHM,5%,2W	01121	HB7555
R3660	305-0755-00			RES.,FXD,CMPSN:7.5M OHM,5%,2W	01121	HB7555
R3750	301-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.50W	01121	EB2235
R3769	311-1257-00			RES.,VAR,NONWIR:5M OHM,20%,0.50W	32997	3386F-T04-505
R3789	303-0565-00			RES.,FXD,CMPSN:5.6M OHM,5%,1W	01121	GB5655
R3820	301-0274-00			RES.,FXD,CMPSN:270K OHM,5%,0.50W	01121	EB2745
R3910	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R3915	301-0224-00			RES.,FXD,CMPSN:220K OHM,5%,0.50W	01121	EB2245
R3920	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R3940	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
S241	260-1794-00 ----- -----			SWITCH,LEVER:1 SECT,3 POSN,30 DEG (1420 ONLY)	80009	260-1794-00
S241	260-1885-00 ----- -----			SWITCH,LEVER:3 POLE,4 POSN,22.5 DEG,PHEN (1421 AND 1422 ONLY)	80009	260-1885-00
S245	260-1793-00			SWITCH,LEVER:1 SECT,3 POSN,30 DEG	80009	260-1793-00
S445	311-0771-00			RES.,VAR,NONWIR:PNL,1K OHM,0.5W/SW	12697	381-CM39686
T230	119-0647-00 ----- -----			GONIOMETER,ELEC:3-58MHZ (1420 AND 1422 ONLY)	80009	119-0647-00
T230	119-0648-00 ----- -----			GONIOMETER,ELEC:4.43 MHZ (1421 ONLY)	80009	119-0648-00
T430	120-1134-00			XFMR,PWR,SDN&SU:	80009	120-1134-00
T1465	120-0526-00			XFMR,TOROID:12 TURN QUADFILAR	80009	120-0526-00
T3510	120-0941-00			XFMR,PWR,SDN&SU:HV	80009	120-0941-00
U1235	156-0067-02			MICROCIRCUIT,LI:OPNL AMPLIFIER,SELECTED	80009	156-0067-02
U1540	156-0158-05			MICROCIRCUIT,LI:DUAL OPERATIONAL AMPLIFIER	80009	156-0158-05
U1548	156-0067-00 ----- -----	B050000	B053201	MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER (1420 ONLY)	02735	85145
U1548	156-0067-11 ----- -----	B053202		MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER (1420 ONLY)	02735	CA741CG
U1548	156-0067-00 ----- -----	B050000	B051250	MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER (1421 ONLY)	02735	85145
U1548	156-0067-11 ----- -----	B051251		MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER (1421 ONLY)	02735	CA741CG
U1548	156-0067-00 ----- -----	B050000	B050188	MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER (1422 ONLY)	02735	85145
U1548	156-0067-11 ----- -----	B050189		MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER (1422 ONLY)	02735	CA741CG
U1614	156-0041-00			MICROCIRCUIT,DI:DUAL D-TYPE FLIP-FLOP	27014	DM7474N
U1715	156-0130-00			MICROCIRCUIT,LI:BALANCED MODEM	80009	156-0130-00
U1755	156-0130-00			MICROCIRCUIT,LI:BALANCED MODEM	80009	156-0130-00

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
U1915	156-0356-00			MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0356-00
U1950	156-0356-00			MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0356-00
V411	154-0788-02			ELECTRON TUBE:CRT,P31,INTERNAL SCALE (1420 ONLY)	80009	154-0788-02
V411	154-0788-01	475-[illegible]		ELECTRON TUBE:CRT,P31,INTERNAL SCALE (1421 ONLY)	80009	154-0788-01
V411	154-0788-00			ELECTRON TUBE:CRT,P31,INTERNAL SCALE (1422 ONLY)	80009	154-0788-00
VR1325	152-0166-00			SEMICOND DEVICE:ZENER,0.4W,6.2V,5%	04713	SZ11738
VR1839	152-0166-00			SEMICOND DEVICE:ZENER,0.4W,6.2V,5%	04713	SZ11738
VR1932	152-0166-00			SEMICOND DEVICE:ZENER,0.4W,6.2V,5%	04713	SZ11738
VR1986	152-0175-00			SEMICOND DEVICE:ZENER,0.4W,5.6V,5%	04713	SZG35008
VR3020	152-0166-00			SEMICOND DEVICE:ZENER,0.4W,6.2V,5%	04713	SZ11738
VR3760	152-0287-00			SEMICOND DEVICE:ZENER,0.4W,110V,5%	04713	1N986B
Y1670	158-0069-00			XTAL UNIT,QTZ:3.579545 MHZ,+/-0.0035% (1420 ONLY)	75378	TX-005
Y1670	158-0075-00			XTAL UNIT,QTZ:4.433619 MHZ,+/-0.0035% (1421 ONLY)	75378	TX-007
Y1670	158-0080-00			XTAL UNIT,QTZ:3.575611 MHZ,+/-0.0035% (1422 ONLY)	80009	158-0080-00

DIAGRAMS AND CIRCUIT BOARD ILLUSTRATIONS

This section of the manual contains block and schematic diagrams with waveforms and etched circuit board illustrations.

Symbols

Symbols used on the diagrams are based on ANSI Y32.2-1970 and IEEE No. 315 March 1971. Logic symbology is based on ANSI Y32.14-1973 (IEEE Std. 91-1973). Logic symbols depict the logic function performed and may differ from the manufacturer's data.

Component Values

Electrical components shown on the diagrams are in the following units unless noted otherwise:

Capacitors = Values one or greater are in picofarads (pF).
Values less than one are in micofarads (μF).

Resistors = Ohms (Ω).

Semiconductor Types

Refer to the Electrical Parts List.

Reference Designators

The following letters are used as reference designators to identify components or assemblies on Tektronix, Inc. schematic diagrams.

A	Assembly, separable or repairable (circuit board, etc.)
AT	Attenuator, fixed or variable
B	Motor
BT	Battery
C	Capacitor, fixed or variable
CR	Diode, signal or rectifier
DH	Decoupling Hybrid
DL	Delay Line
DS	Indicating device (lamp)
E, SG	Spark Gap
F	Fuse
FL	Filter
H	Heat dissipating device (heat sink, heat radiator, etc.)
HR	Heater
J	Connector, stationary portion
K	Relay
L	Inductor, fixed or variable
LR	Inductor/resistor combination
M	Meter
P	Connector, movable portion
Q	Transistor, silicon-controlled rectifier, or programmable unijunction transistor
R	Resistor, fixed or variable
RT	Thermistors
S	Switch
T	Transformer
TC	Thermocouple
TP	Test Point
U	Assembly, inseparable or non-repairable (integrated circuit, etc.)
V	Electron tube
VR	Voltage regulator (zener diode, etc.)
Y	Crystal

Partial Schematic Diagram With Explanations

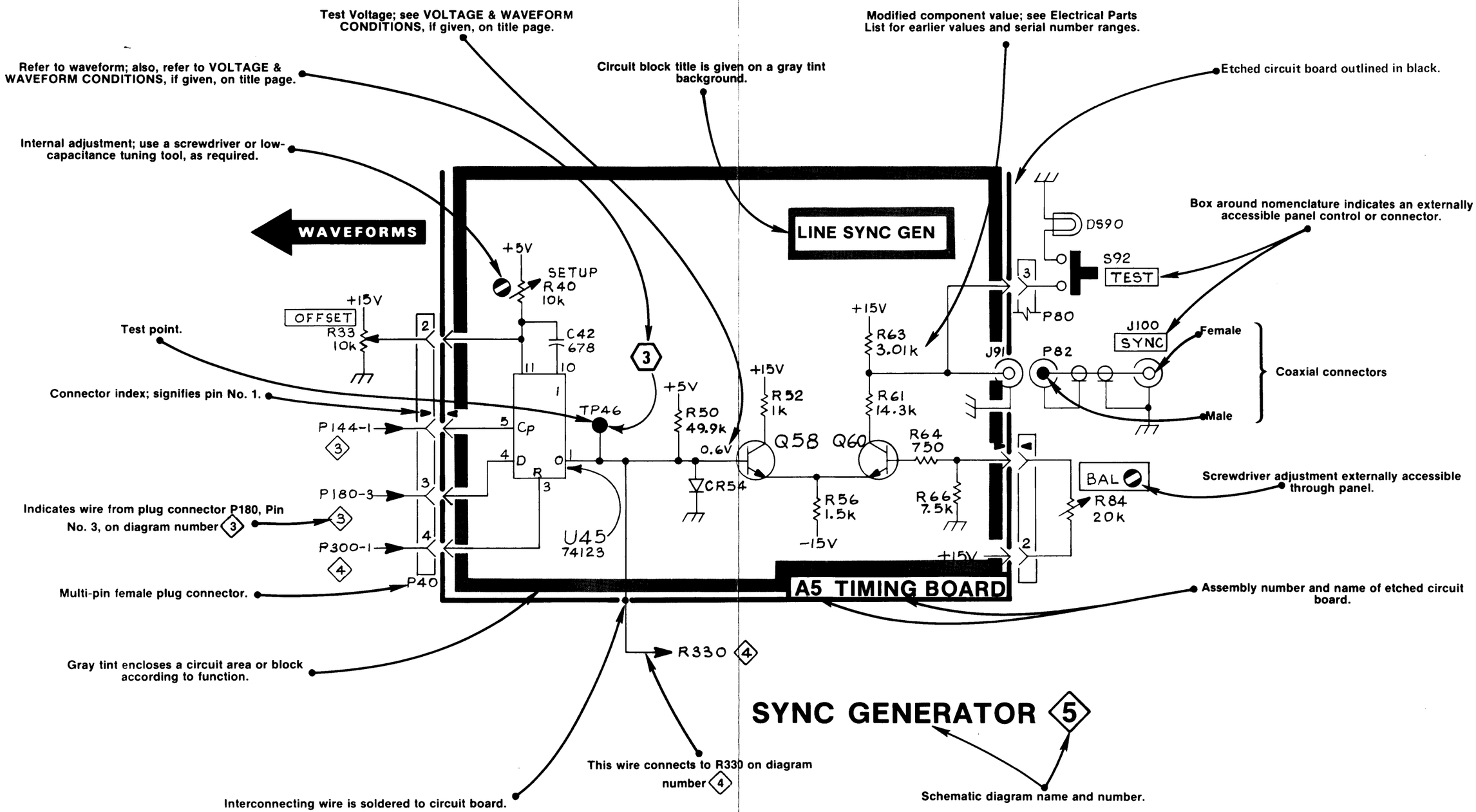
The partial diagram at the left is an example of the various symbols and other information provided on Tektronix, Inc. diagrams.

Transformer Wiring

A two-letter abbreviation color code is used to identify wires without terminal connection labels.

Bk	Black
Br	Brown
Rd	Red
Or	Orange
Yl	Yellow
G	Green
Bl	Blue
Vi	Violet
Gy	Gray
W	White

SCHEMATIC EXAMPLE



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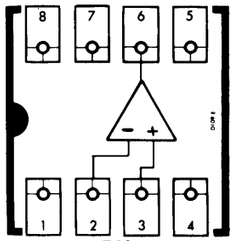
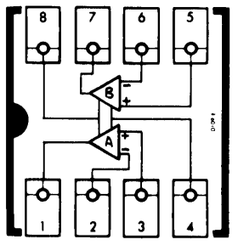
@

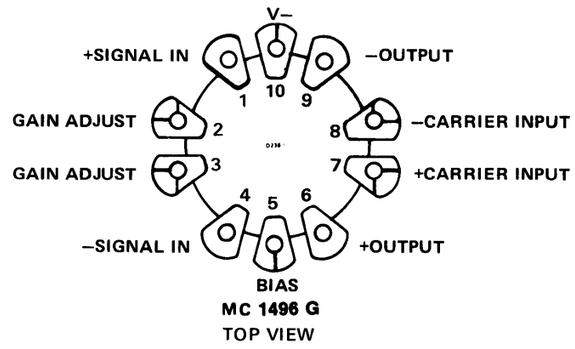
IC LOGIC DIAGRAMS



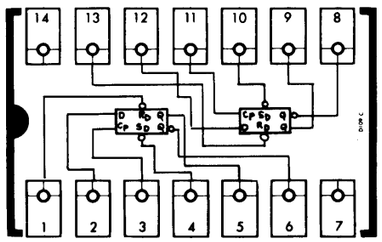
741



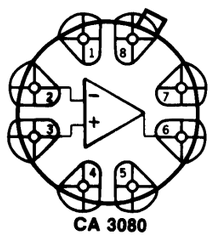
5558



MC 1496 G
TOP VIEW



7474



CA 3080

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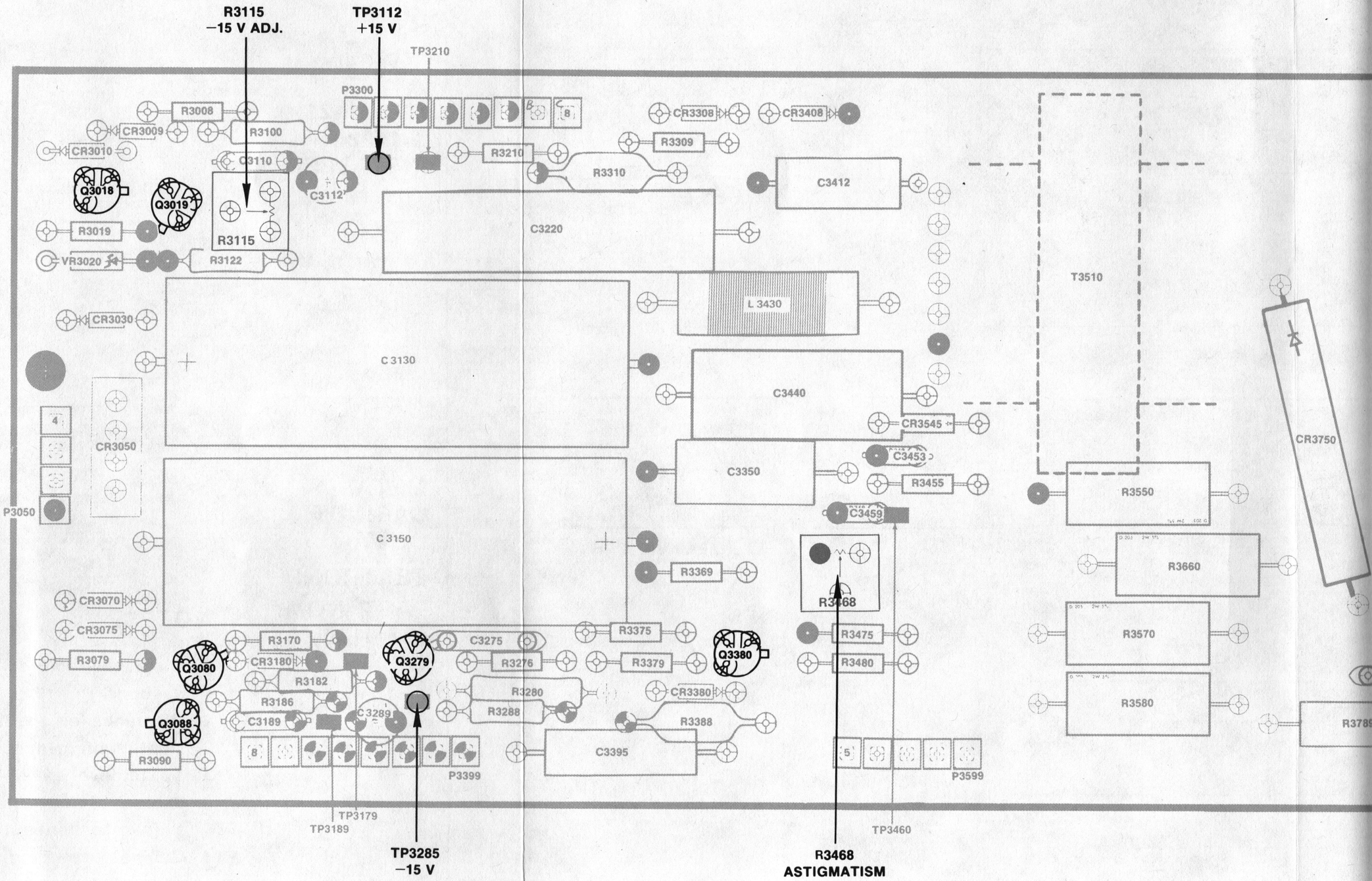
WAVEFORM CONDITIONS

Waveform photographs in this section were taken with a TEKTRONIX C-59 Oscilloscope camera mounted on a TEKTRONIX 7603 Oscilloscope with 7B53A Time Base and 7A18 Dual Trace Amplifier Plug-ins.


R3115
−15 V ADJ.
TP3112
+15 V
TP3210
P3300
R3008
CR3009
CR3010
R3100
C3110
C3112
R3210
R3309
R3310
CR3308
CR3408
C3412
Q3018
Q3019
R3019
VR3020
R3122
R3115
C3220
T3510
CR3030
C 3130
L 3430
C3440
CR3545
CR3750
CR3050
P3050
C3453
C3350
R3455
R3550
C3459
C 3150
R3369
R3660
R3468
R3475
R3480
R3570
CR3070
CR3075
R3079
R3170
CR3180
R3182
R3186
C3189
C3289
Q3080
Q3279
C3275
R3276
R3280
R3288
R3375
R3379
Q3380
CR3380
R3388
R3580
Q3088
R3090
C3395
P3399
P3599
TP3179
TP3189
TP3460
TP3285
−15 V
R3468
ASTIGMATISM

@

TP3812
+210 V

TP3210

CR3308
CR3408
R3309
R3210
R3310
C3412
C3220
L 3430
T3510
C3730
C3731
Q3905
R3910
P3900
R3915
R3920
R3820
CR3925
CR3930
CR3935
CR3939
R3940
7
C3440
CR3545
C3453
C3350
R3455
R3550
CR3750
C3459
R3750
VR3760
R3660
R3369
R3468
R3769
C3275
R3375
R3475
Q3279
R3276
R3379
Q3380
R3480
R3280
CR3380
C3780
R3288
R3388
R3789
C3395
5
P3399
P3599
TP3460

2899-58

TP3285
−15 V

R3468
ASTIGMATISM

R3769
INTENSITY LIMIT

FIG. 9-1. POWER SUPPLY ADJUSTMENT LOCATIONS.

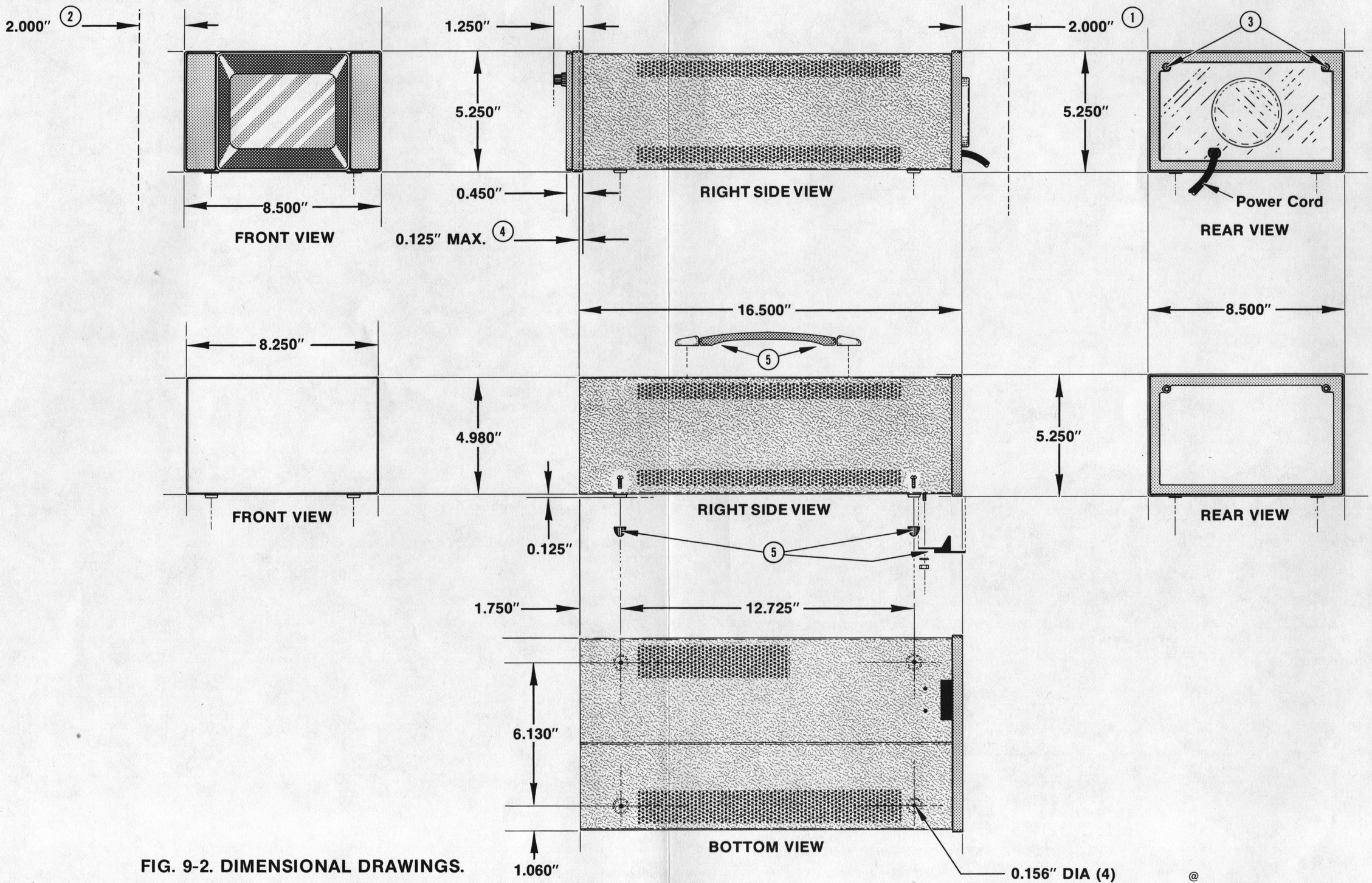
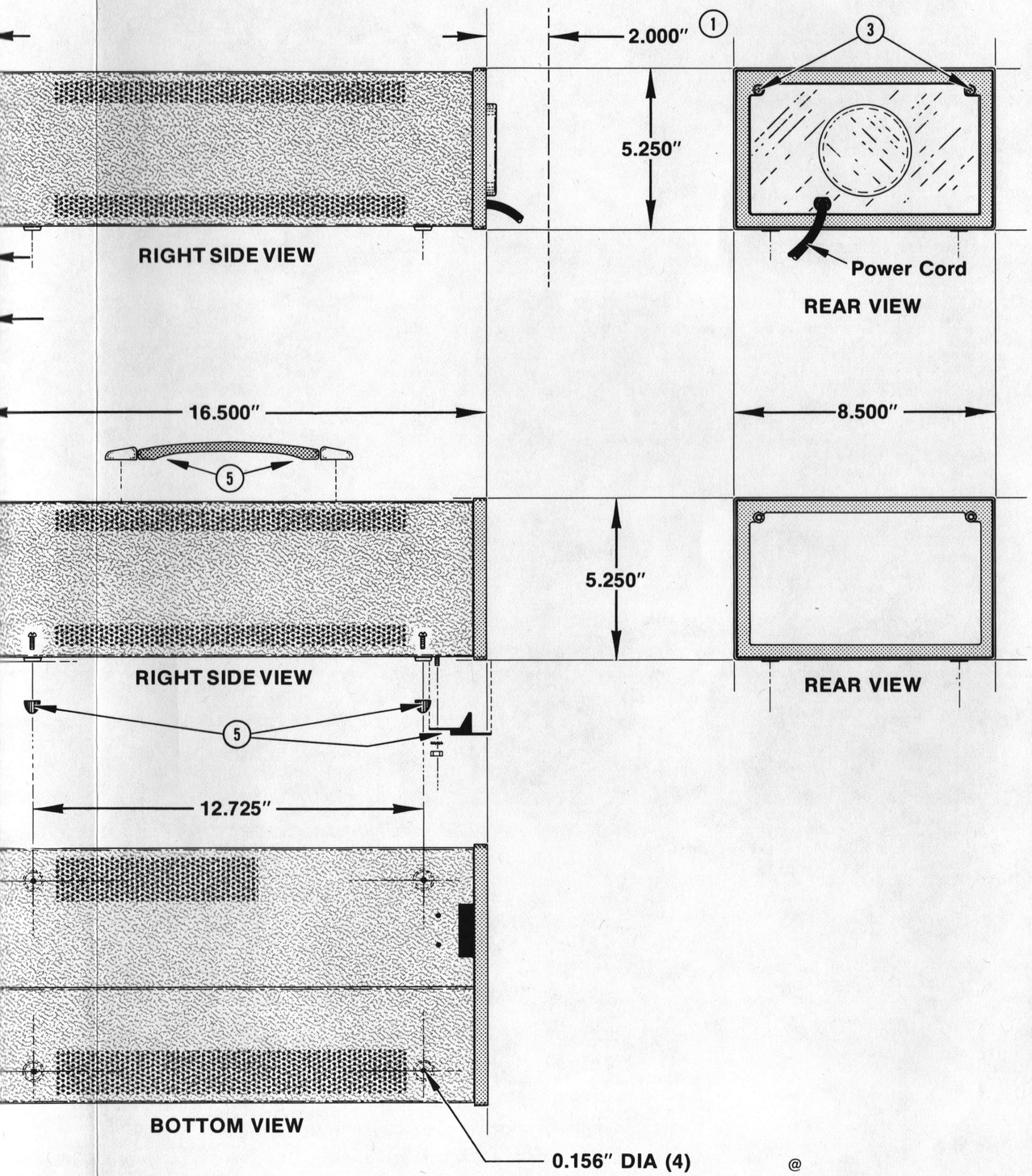


FIG. 9-2. DIMENSIONAL DRAWINGS.



1420, 1421, & 1422 INSTALLED

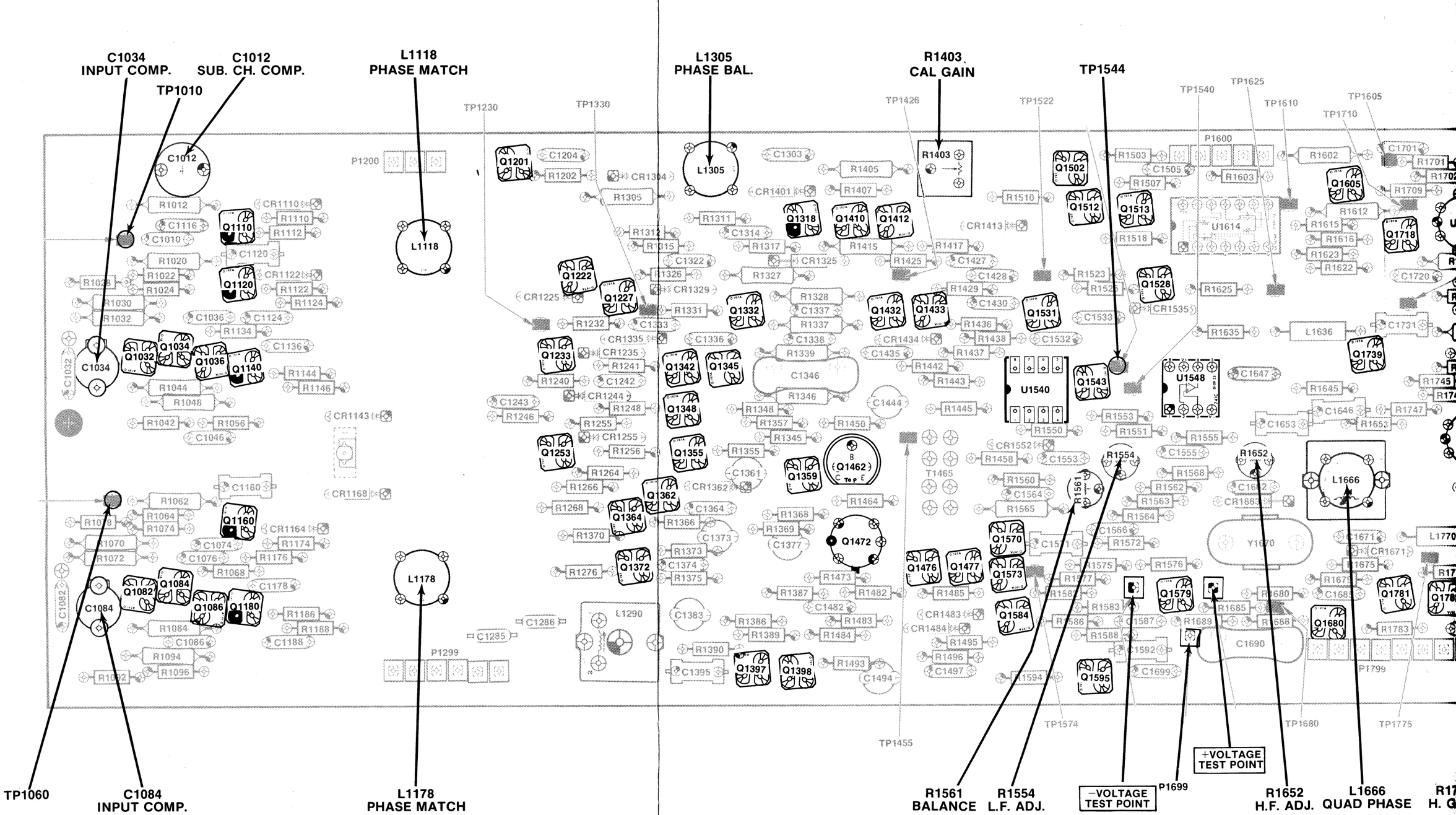
METAL CABINET ONLY

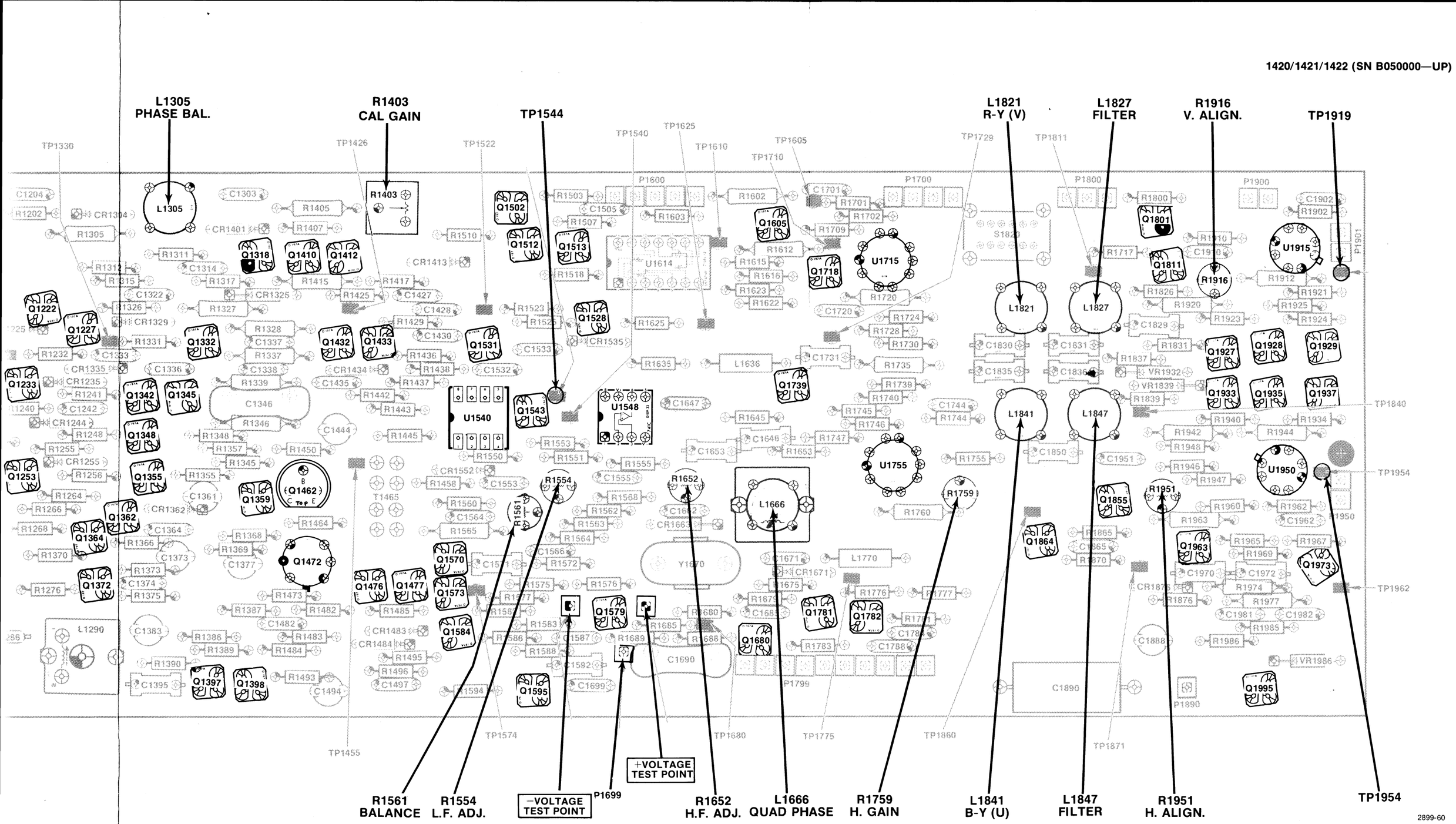
TEKTRONIX PART NO. 437-0100-00

NOTES:

1. Clearance required for cooling and connections.
2. Clearance (on one side or 1.000″ on each side) recommended for air circulation.
3. To remove 1420, 1421, & 1422 from cabinet: Remove these two screws and slide instrument out thru front of cabinet.
4. Cabinet insertion distance into front sub panel casting.
5. Portable usage only, see Mechanical Installation in Section 3.

2899-59


C1034
INPUT COMP.
C1012
SUB. CH. COMP.
TP1010
L1118
PHASE MATCH
L1305
PHASE BAL.
R1403
CAL GAIN
TP1544
TP1230
TP1330
TP1426
TP1522
TP1540
TP1625
TP1610
TP1605
TP1710
P1600
P1200
L1118
L1305
R1403
C1012
C1034
C1084
L1178
L1290
P1299
TP1455
TP1574
TP1680
TP1775
P1799
P1699
U1540
U1548
U1614
Y1670
Q1201
Q1110
Q1120
Q1034
Q1032
Q1036
Q1140
Q1222
Q1227
Q1233
Q1253
Q1318
Q1410
Q1412
Q1332
Q1342
Q1345
Q1348
Q1355
Q1359
Q1362
Q1364
Q1372
Q1432
Q1433
Q1531
Q1502
Q1512
Q1513
Q1605
Q1528
Q1543
Q1718
Q1739
Q1160
Q1084
Q1082
Q1086
Q1180
Q1397
Q1398
Q1472
Q1476
Q1477
Q1570
Q1573
Q1584
Q1579
Q1595
Q1680
Q1781
R1561
BALANCE
R1554
L.F. ADJ.
−VOLTAGE
TEST POINT
+VOLTAGE
TEST POINT
R1652
H.F. ADJ.
L1666
QUAD PHASE
TP1060
C1084
INPUT COMP.
L1178
PHASE MATCH



2899-60

FIG. 9-3. DEMODULATOR ADJUSTMENT LOCATIONS.

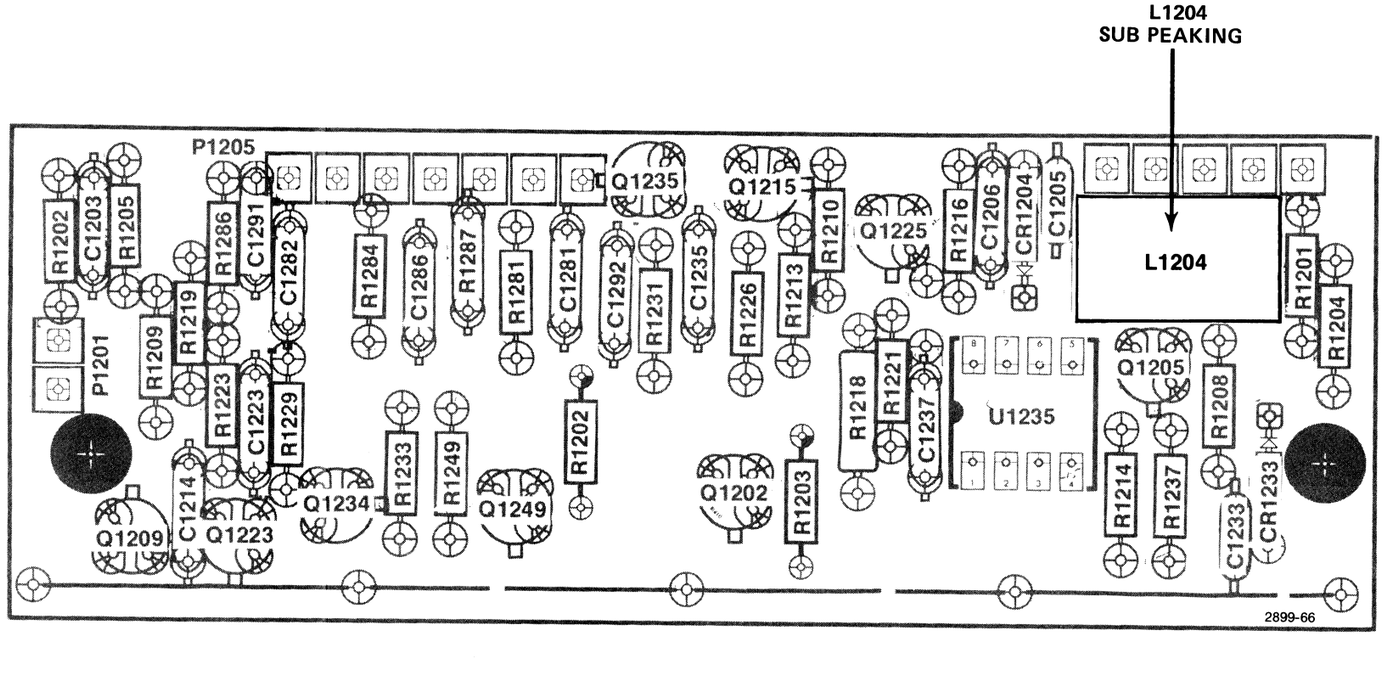
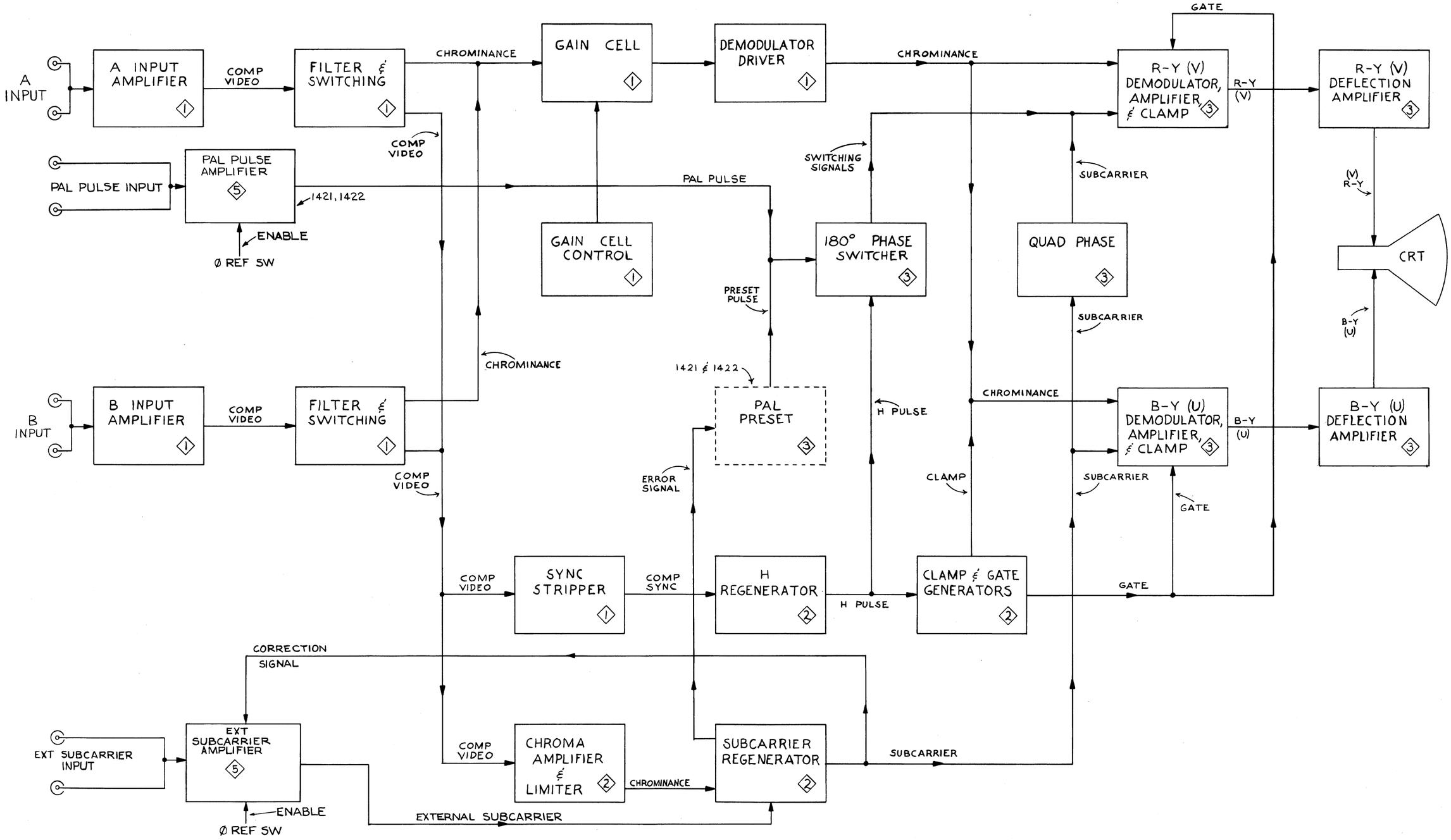


FIG. 9-4. EXT SUB REF ADJUSTMENT LOCATIONS.

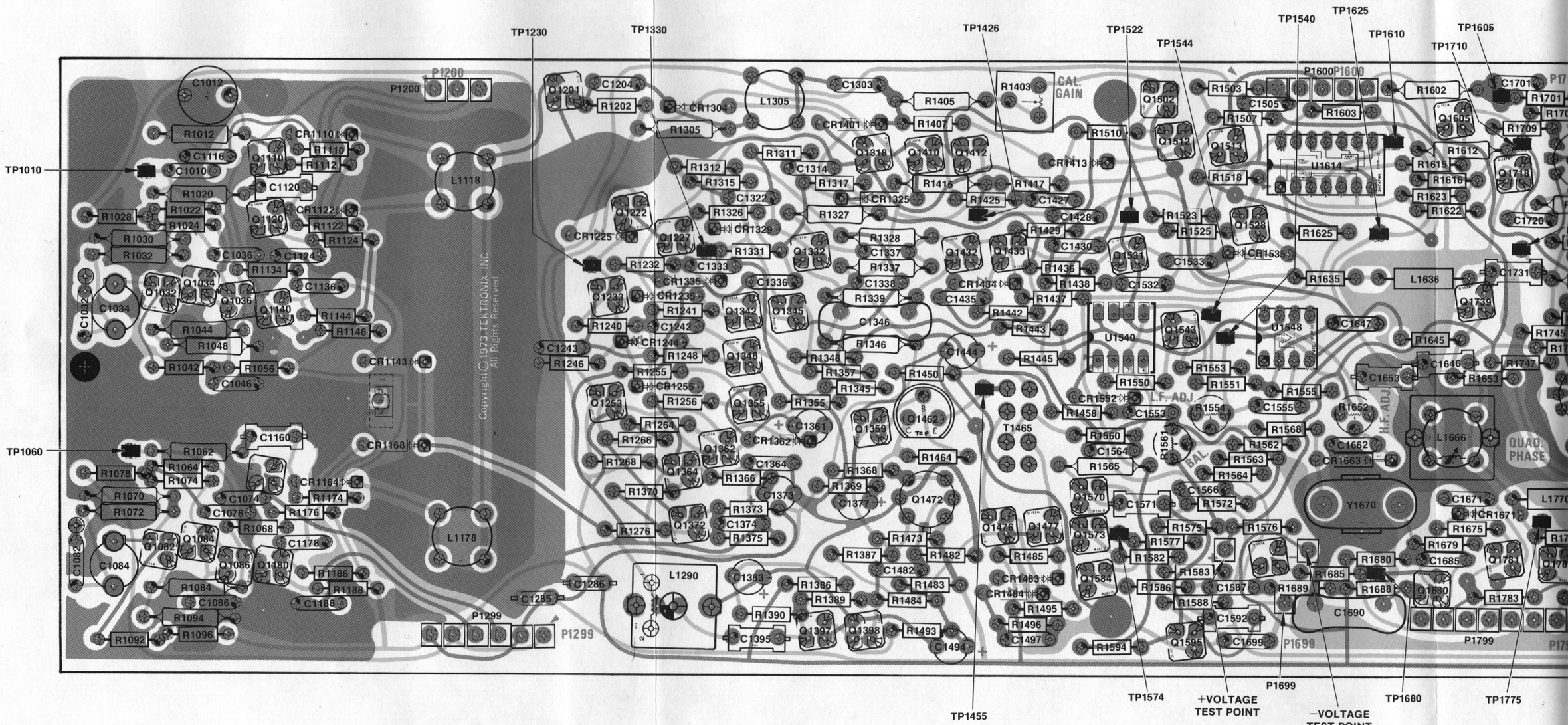
@



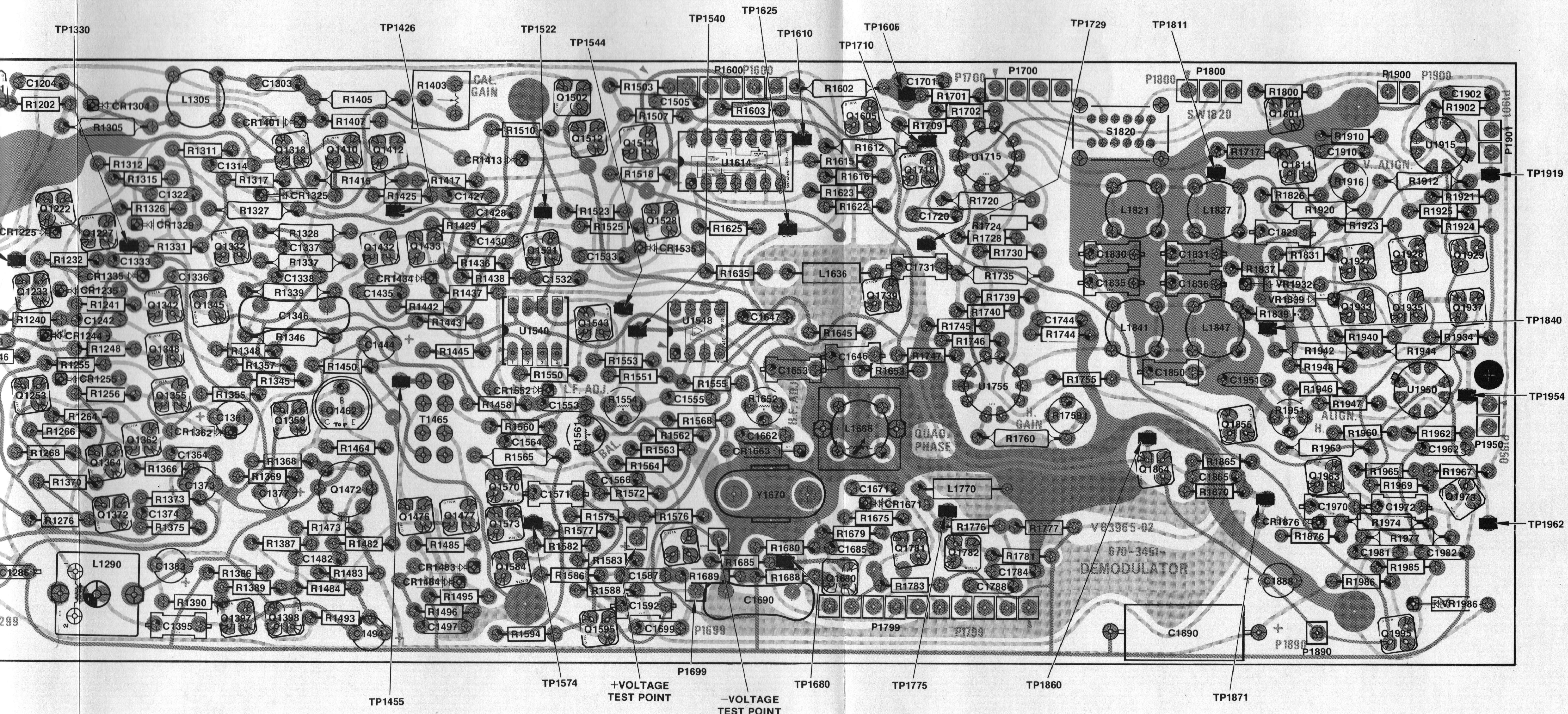
1420, 1421, & 1422
(SN B050000 & UP)
@

2899-55
@

BLOCK DIAGRAM



A1 DEMODULATOR CIRCUIT BOARD


TP1330
TP1426
TP1522
TP1544
TP1540
TP1625
TP1610
TP1605
TP1710
TP1729
TP1811
TP1919
TP1840
TP1954
TP1962
TP1455
TP1574
+VOLTAGE TEST POINT
P1699
−VOLTAGE TEST POINT
TP1680
TP1775
TP1860
TP1871
CAL. GAIN
L.F. ADJ.
H.F. ADJ.
QUAD. PHASE
H. GAIN
V. ALIGN.
H. ALIGN.
BAL.
670-3451-
DEMODULATOR
VB3965-02

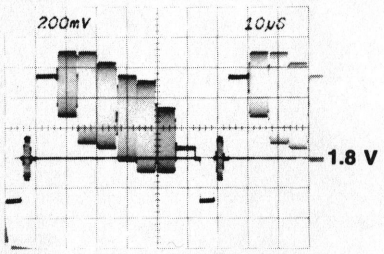
@

2899-61

1

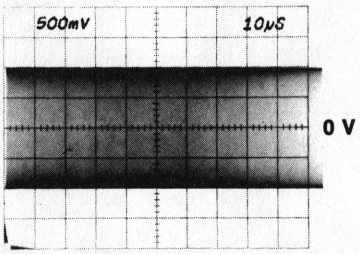
1420

1



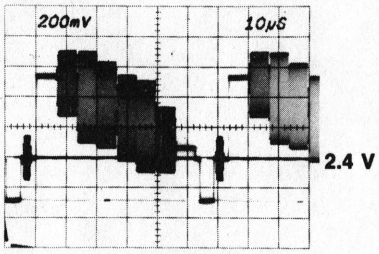
AC COUPLED

2



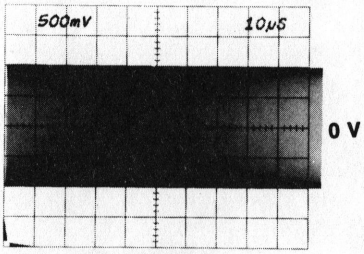
AC COUPLED

3



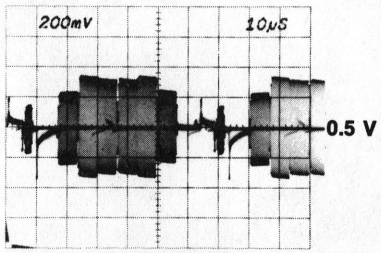
AC COUPLED

4



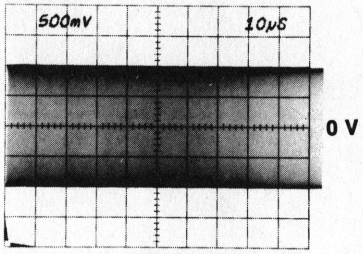
AC COUPLED

5



DC COUPLED

6



AC COUPLED

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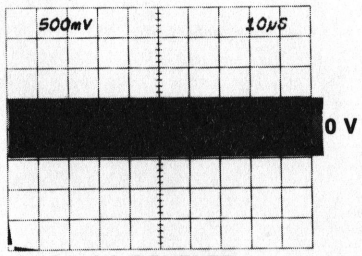
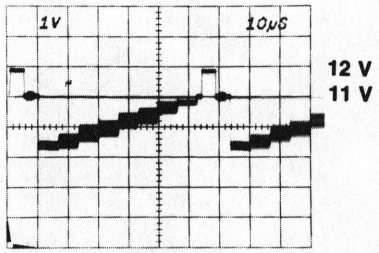


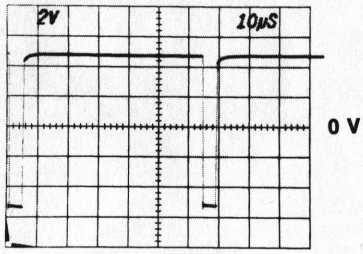
AC COUPLED

8



AC COUPLED

9

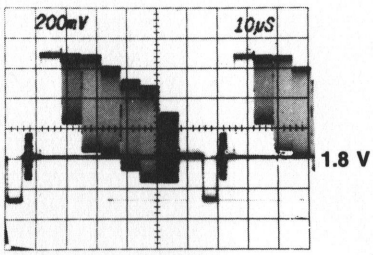


DC COUPLED

1

1421 and 1422

1



AC COUPLED

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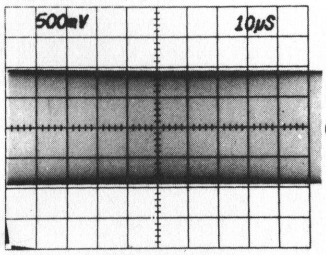
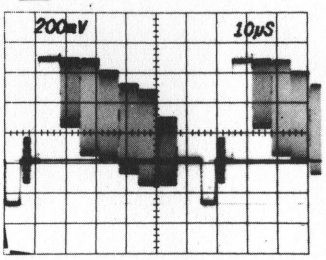


AC COUPLED

3



AC COUPLED

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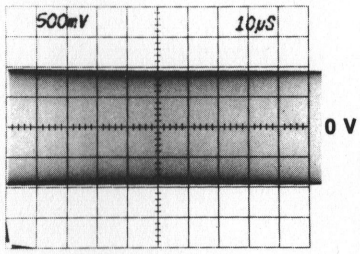
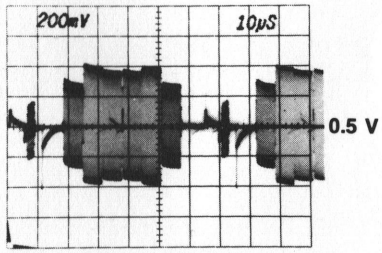


AC COUPLED

5



DC COUPLED

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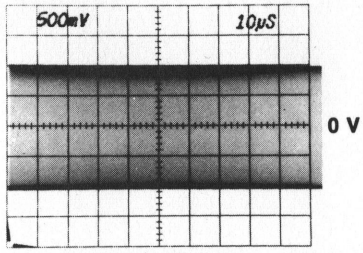
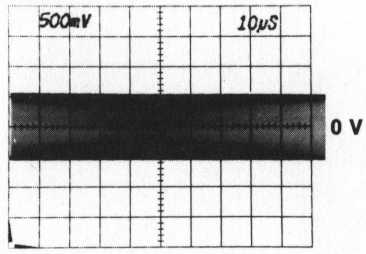


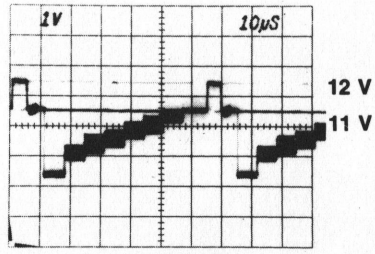
AC COUPLED

7



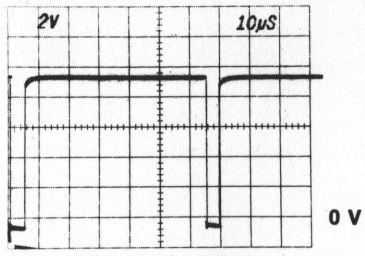
AC COUPLED

8

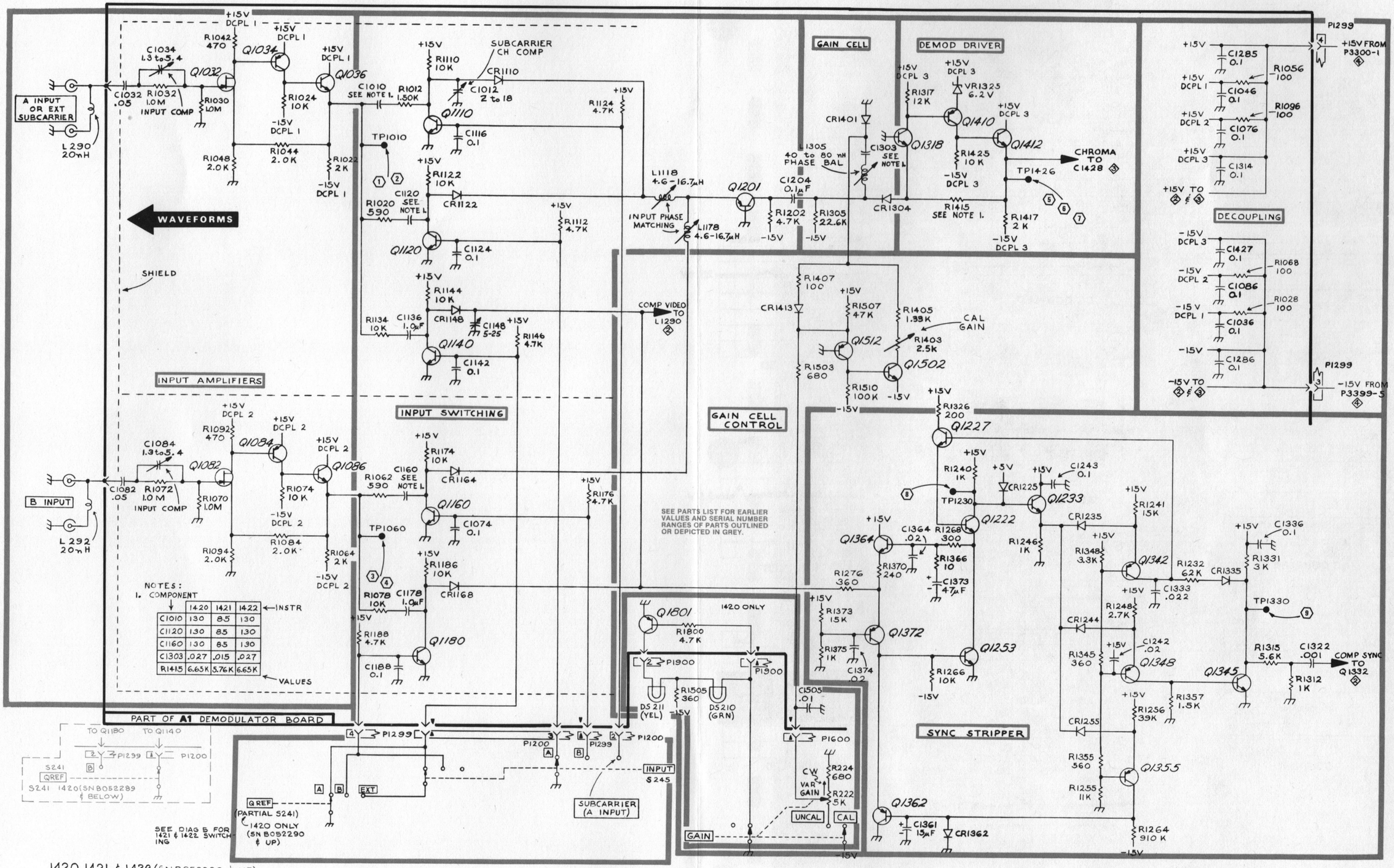


AC COUPLED

9



DC COUPLED



1420, 1421, & 1422 (SN B050000 & UP)

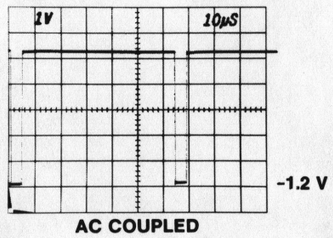
2899-54

INPUT PROCESSING ⟨1⟩

2

1420

1



AC COUPLED

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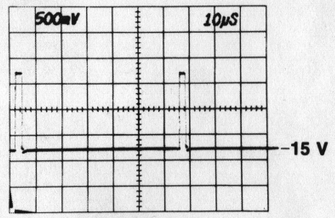

AC COUPLED

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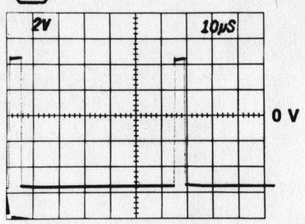

AC COUPLED

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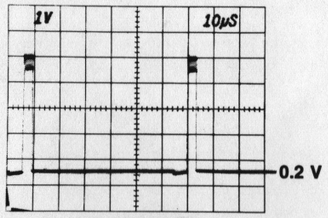

DC COUPLED

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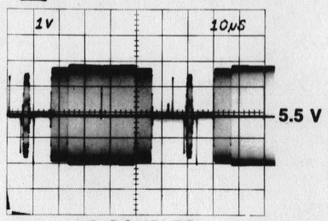

AC COUPLED

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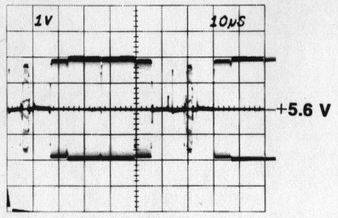
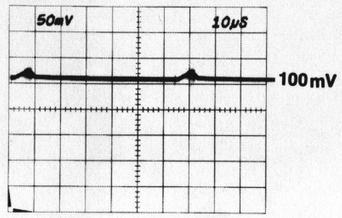


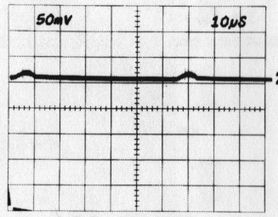
AC COUPLED

7



DC COUPLED

8



DC COUPLED

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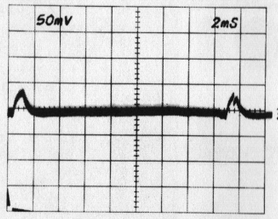

DC COUPLED

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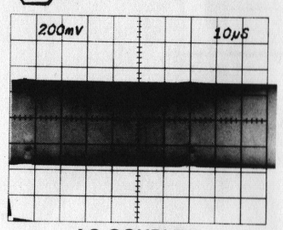


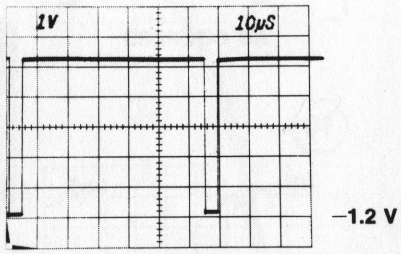
AC COUPLED

2032-68

2

1421 and 1422

1



AC COUPLED

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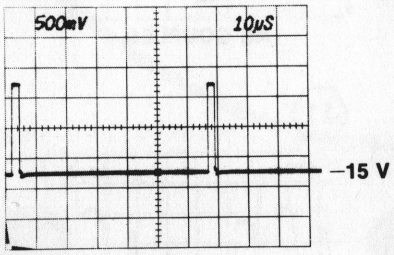

AC COUPLED

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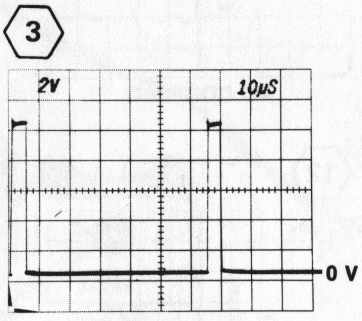

DC COUPLED

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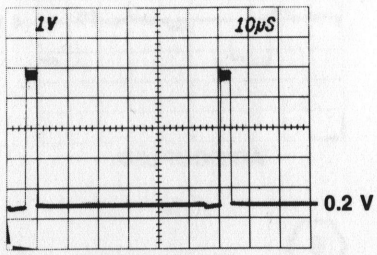

DC COUPLED

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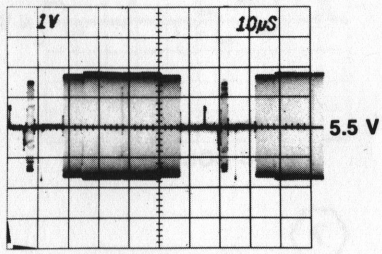
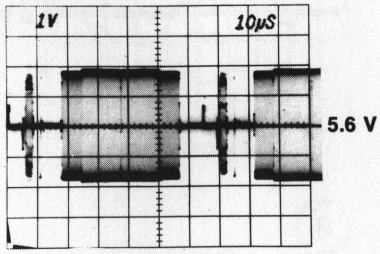


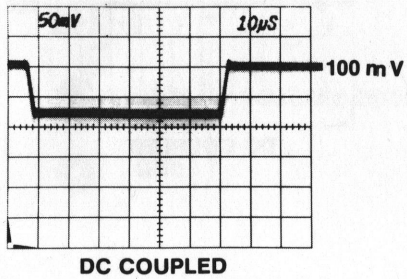
AC COUPLED

6



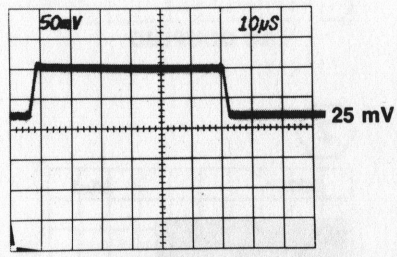
AC COUPLED

7



DC COUPLED

8



DC COUPLED

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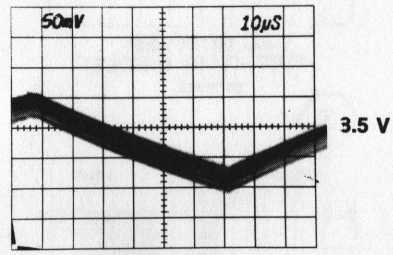

AC COUPLED

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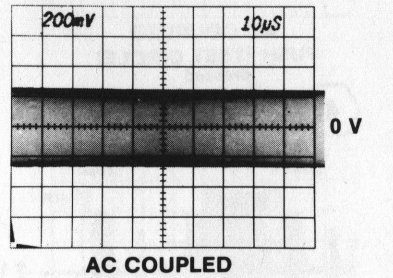
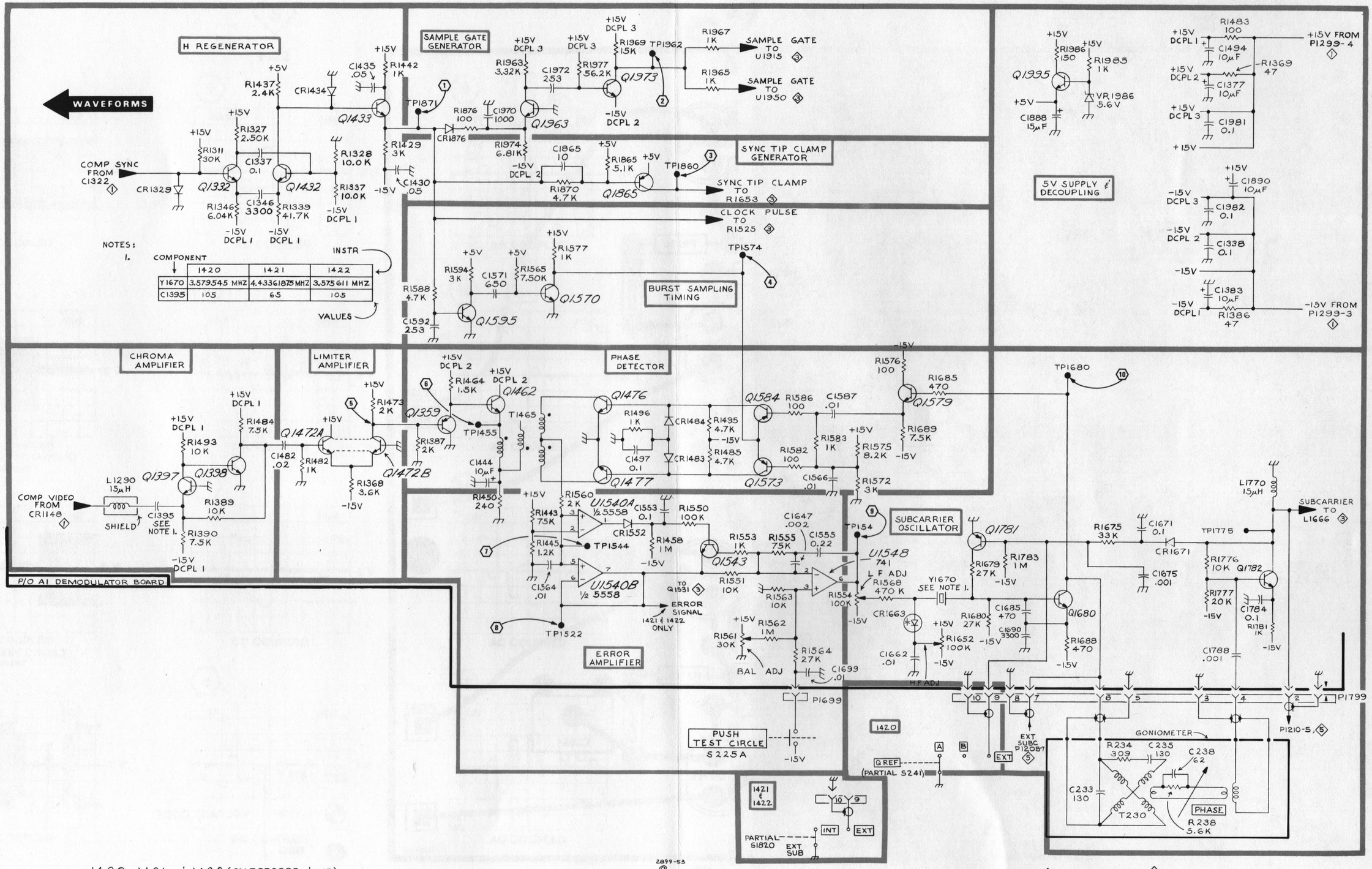


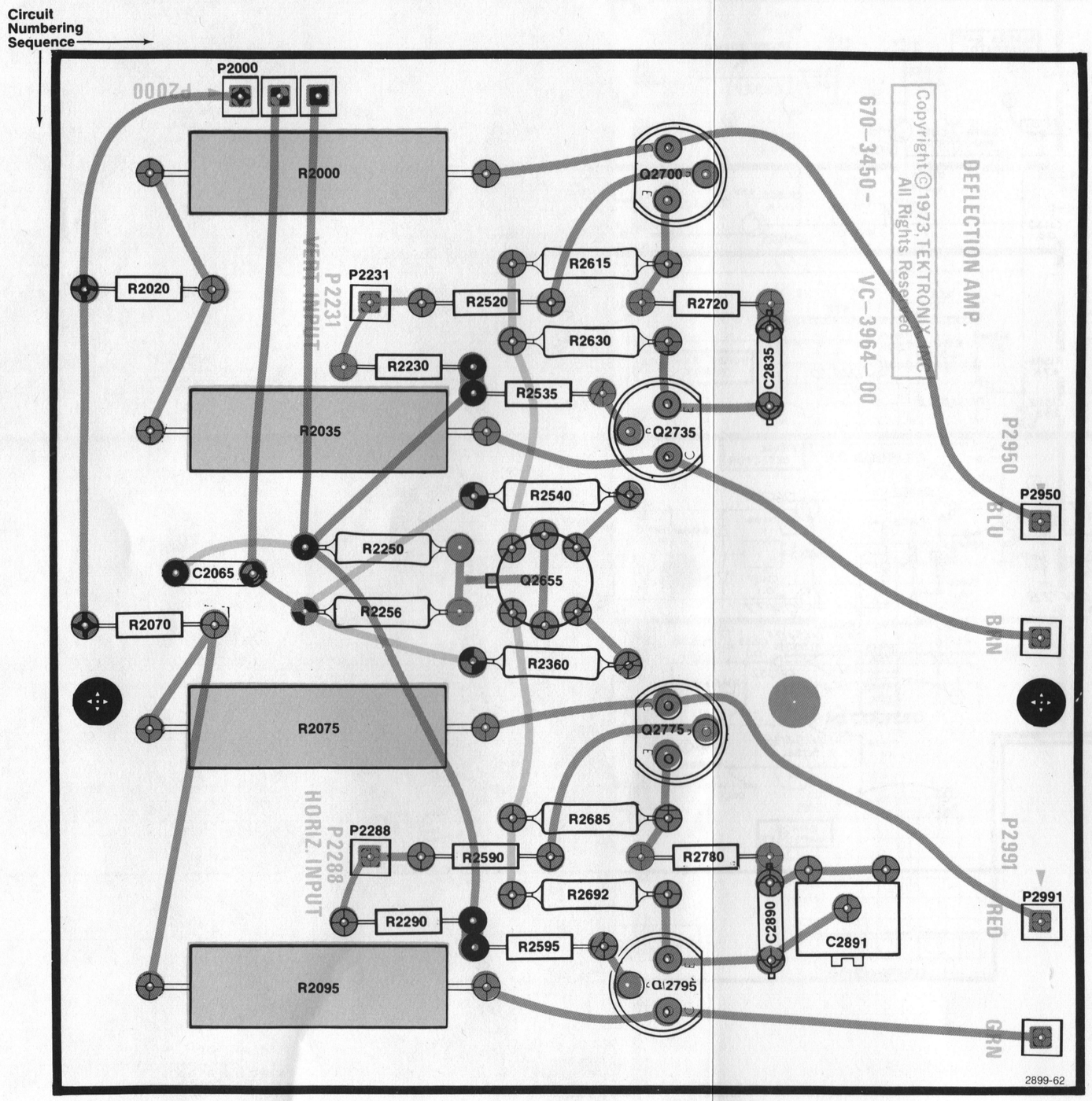
AC COUPLED

2032-69



1420, 1421, & 1422 (SN B050000 & UP)

PHASE LOCK & TIMING 2



+210 V
−15 V
GND
VOLTAGE CODE

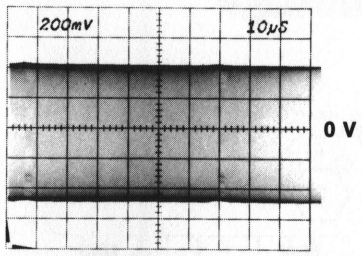
For Demodulator circuit board illustration, see the back of the Block Diagram.

A2 DEFLECTION CIRCUIT BOARD

3

1420

1



AC COUPLED

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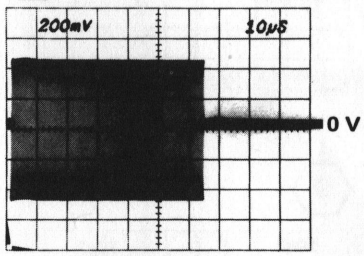
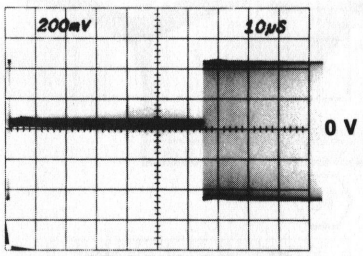


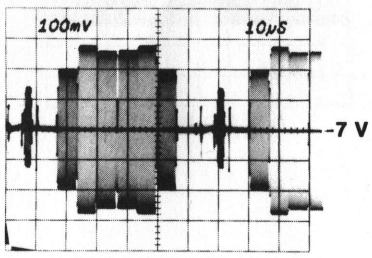
AC COUPLED
PUSH (TEST CIRCLE)
pressed

3



AC COUPLED
PUSH (TEST CIRCLE)
pressed

4



AC COUPLED

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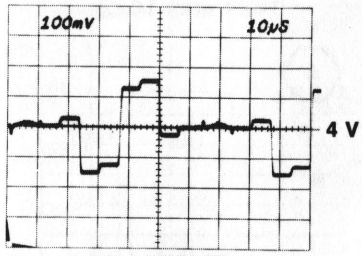
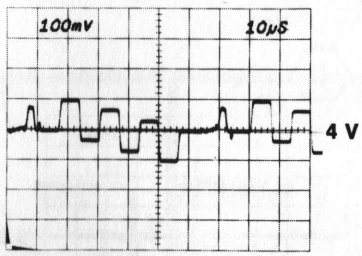


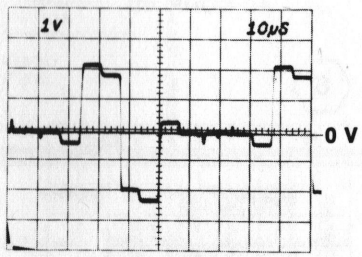
AC COUPLED

6



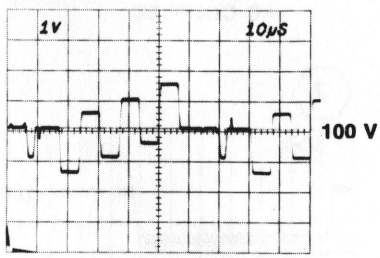
DC COUPLED

7



DC COUPLED

8



DC COUPLED

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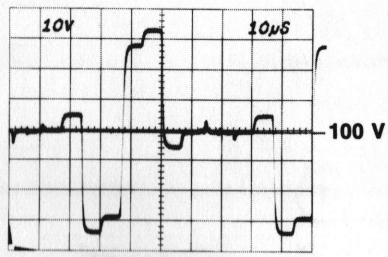

AC COUPLED

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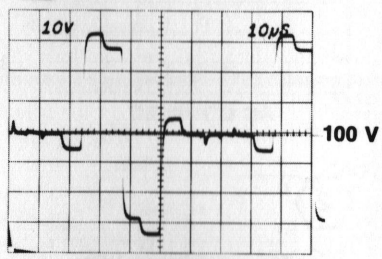
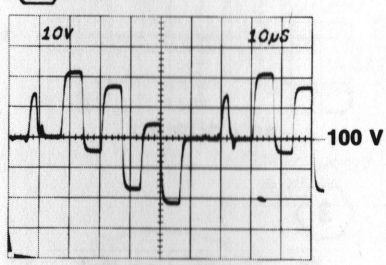


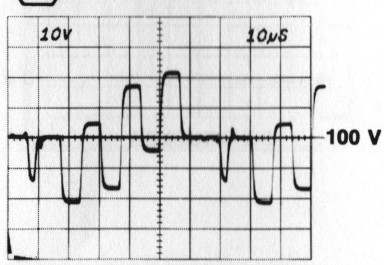
AC COUPLED

11



AC COUPLED

12



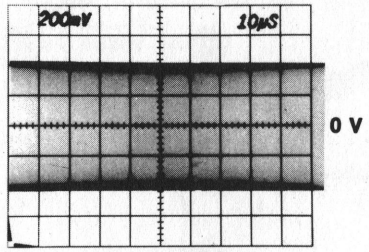
AC COUPLED

2032-70

3

1421 and 1422

1



AC COUPLED

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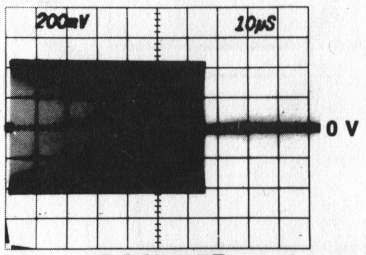
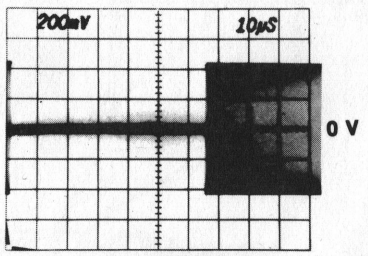


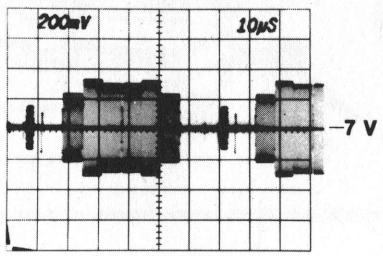
AC COUPLED
PUSH (TEST CIRCLE)
pressed

3



AC COUPLED
PUSH (TEST CIRCLE)
pressed

4



AC COUPLED

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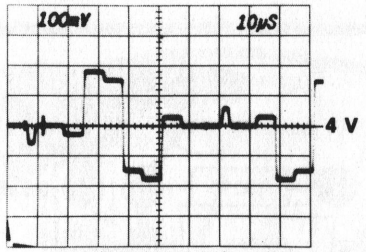
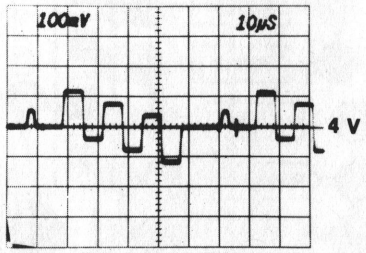


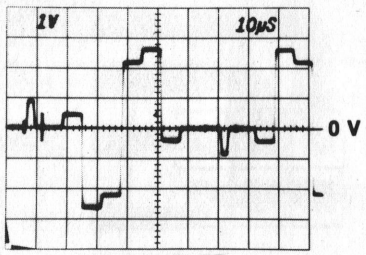
AC COUPLED

6



DC COUPLED

7



DC COUPLED

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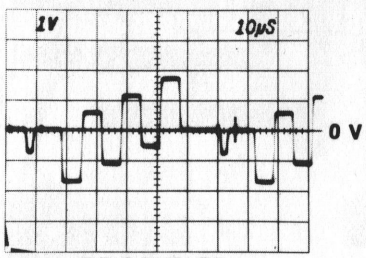

DC COUPLED

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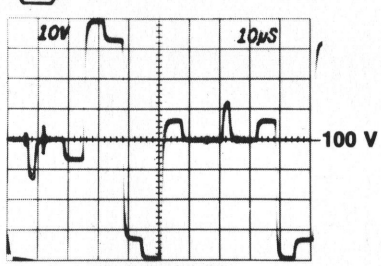

AC COUPLED

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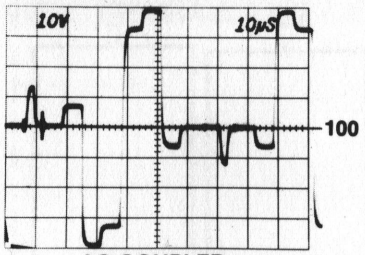

AC COUPLED

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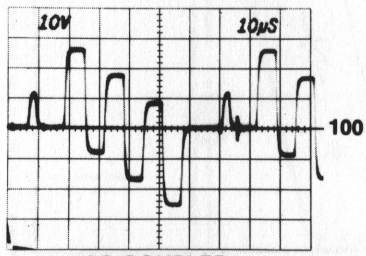

AC COUPLED

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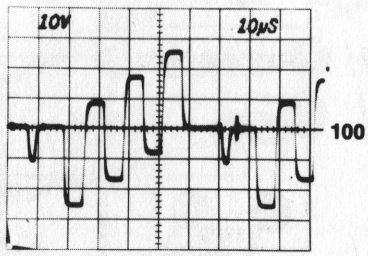

AC COUPLED

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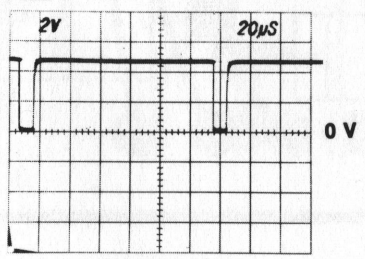
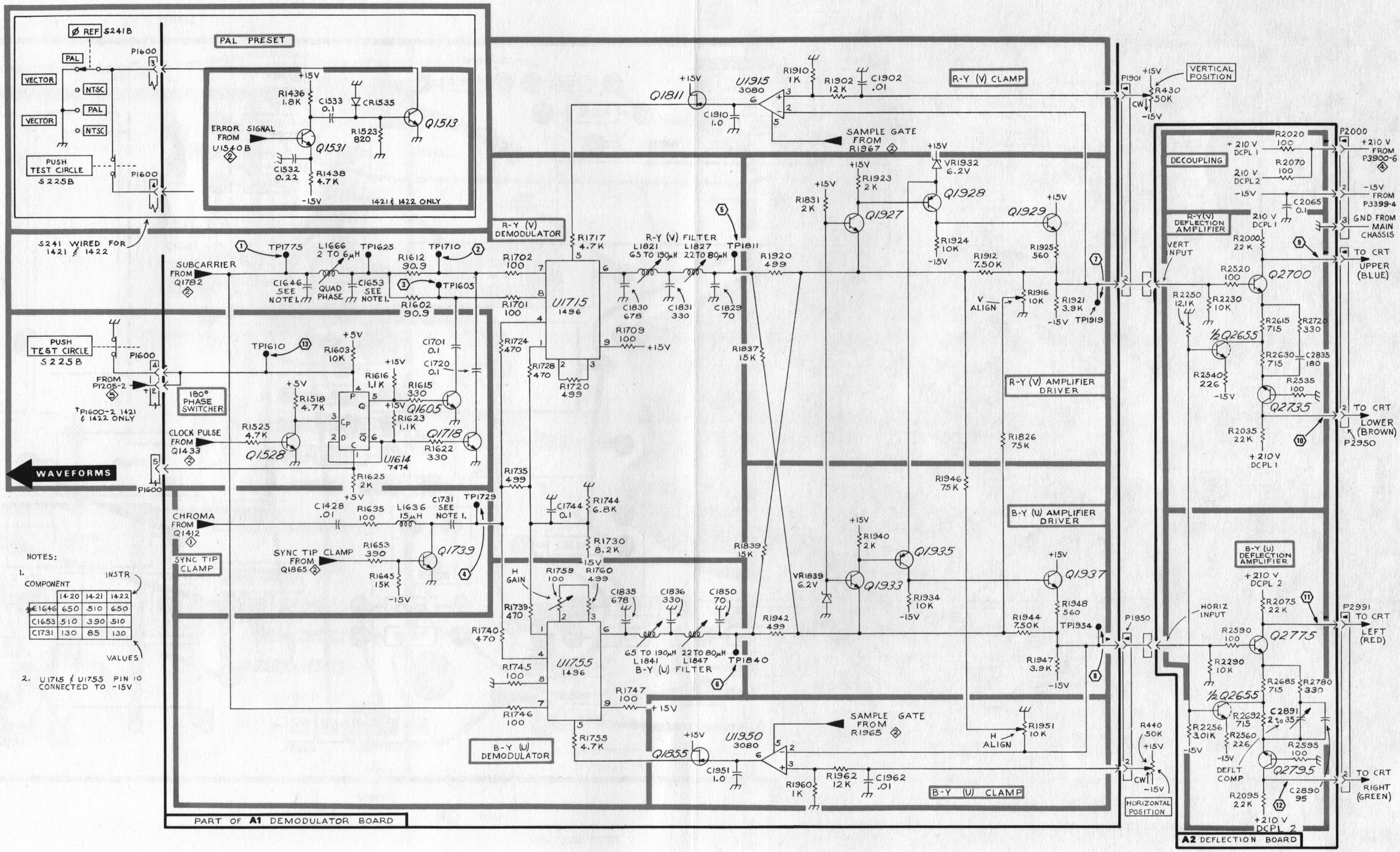


REF in NTSC



NOTES:

1. INSTR

COMPONENT	1420	1421	1422
C1646	650	510	650
C1653	510	390	510
C1731	130	85	130

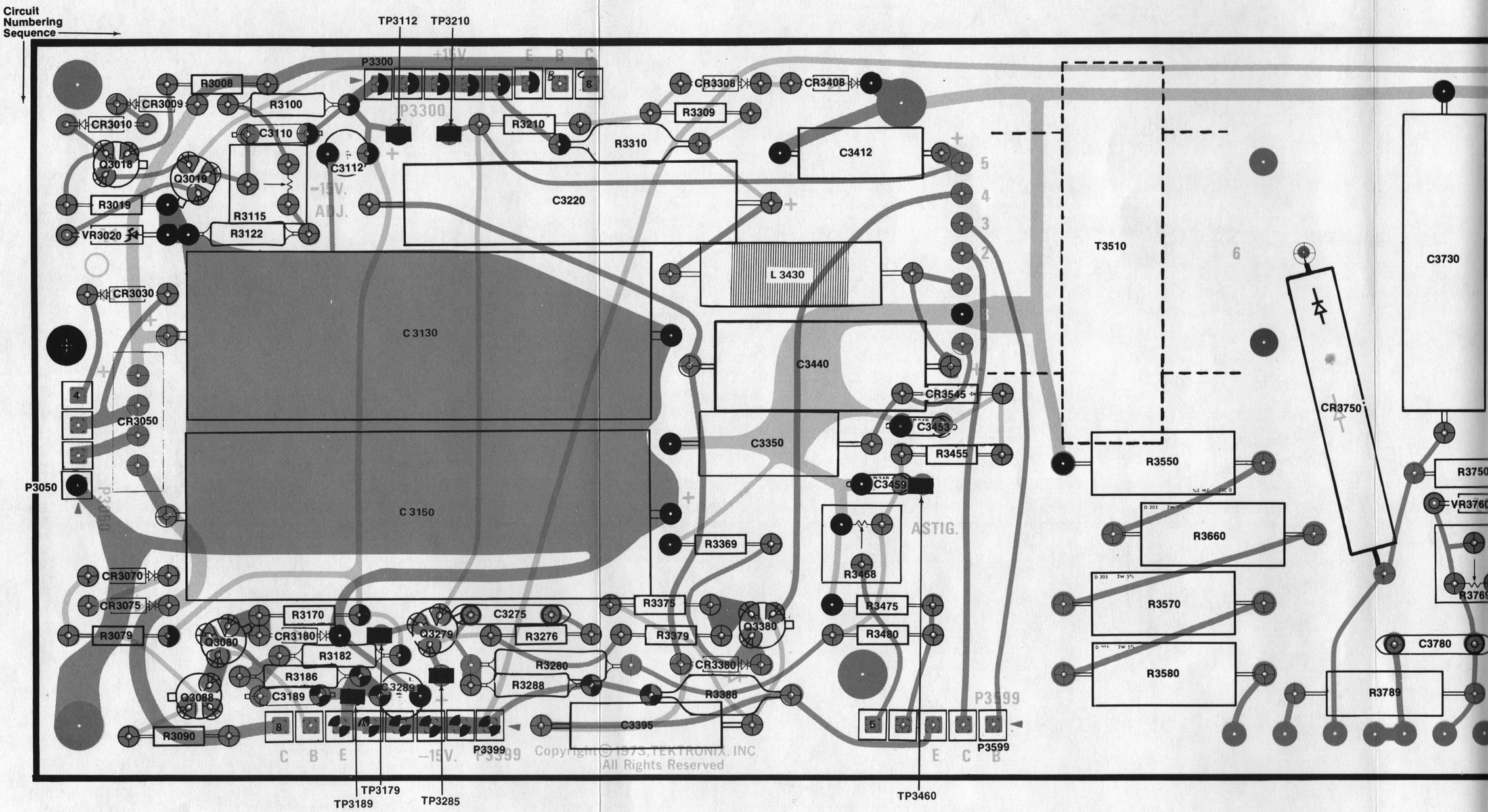
VALUES

2. U1715 & U1755 PIN 10 CONNECTED TO -15V

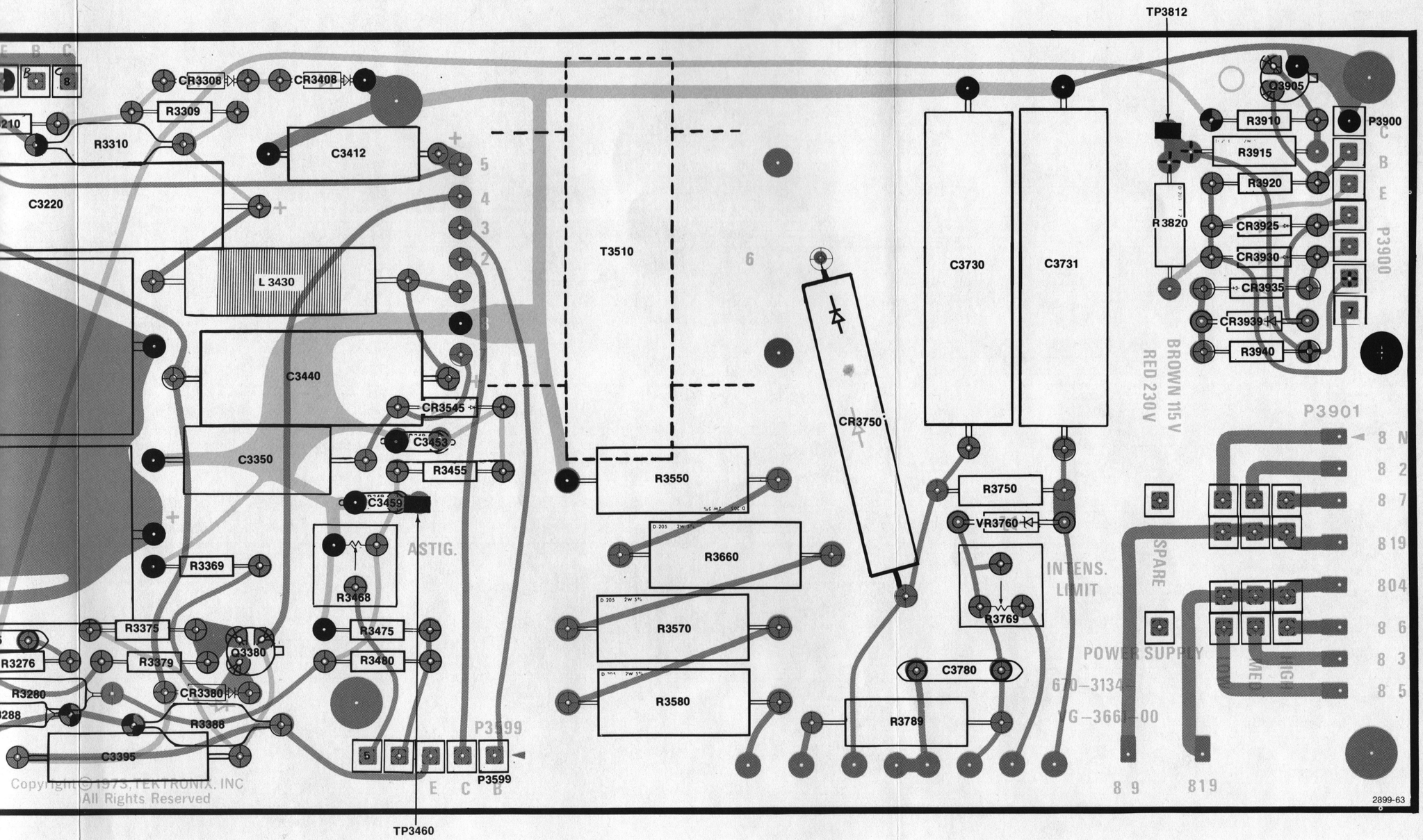
1420, 1421, & 1422 (SN B050000 & UP)

2899-52

DEMODULATOR & DEFLECTION AMPLIFIER ◇3

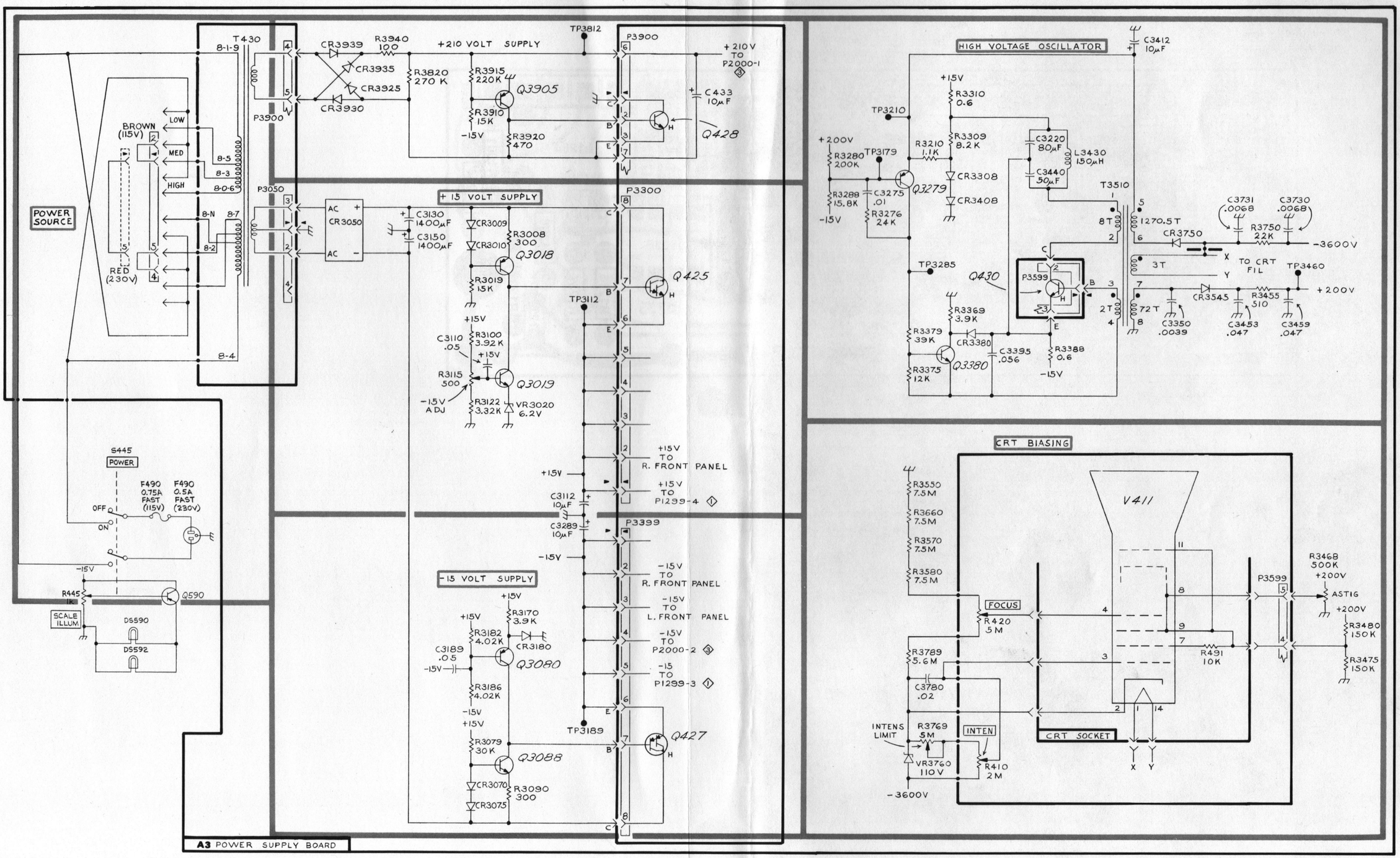


A3 POWER SUPPLY CIRCUIT BOARD



+210 V
−15 V
+15 V
GND
VOLTAGE CODE

@

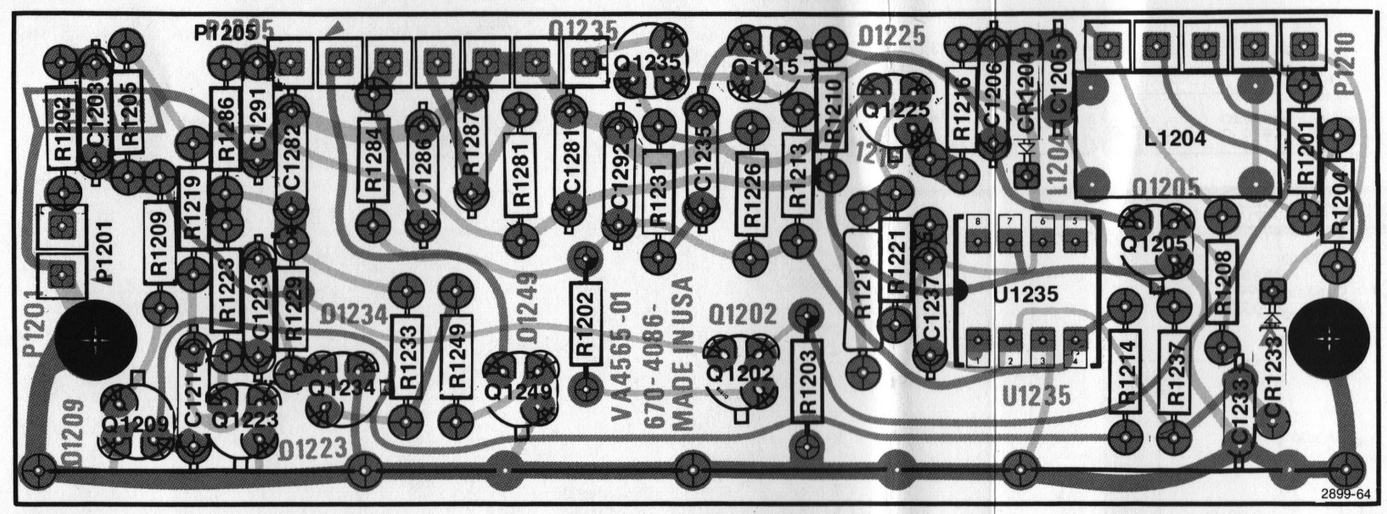


1420, 1421, & 1422 (SN B050000 & UP)

2899-51

POWER SUPPLIES & CRT 4

Circuit Numbering Sequence

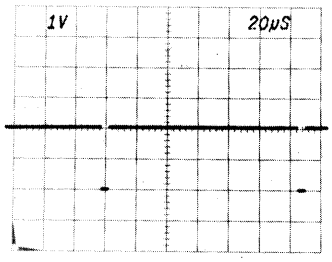


A5 EXT SUB REF BOARD

@

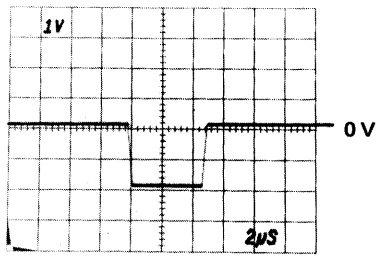
1421 and 1422

1



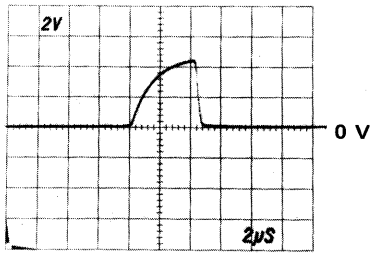
DC COUPLED

2



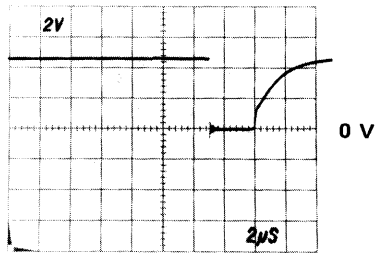
DC COUPLED

3



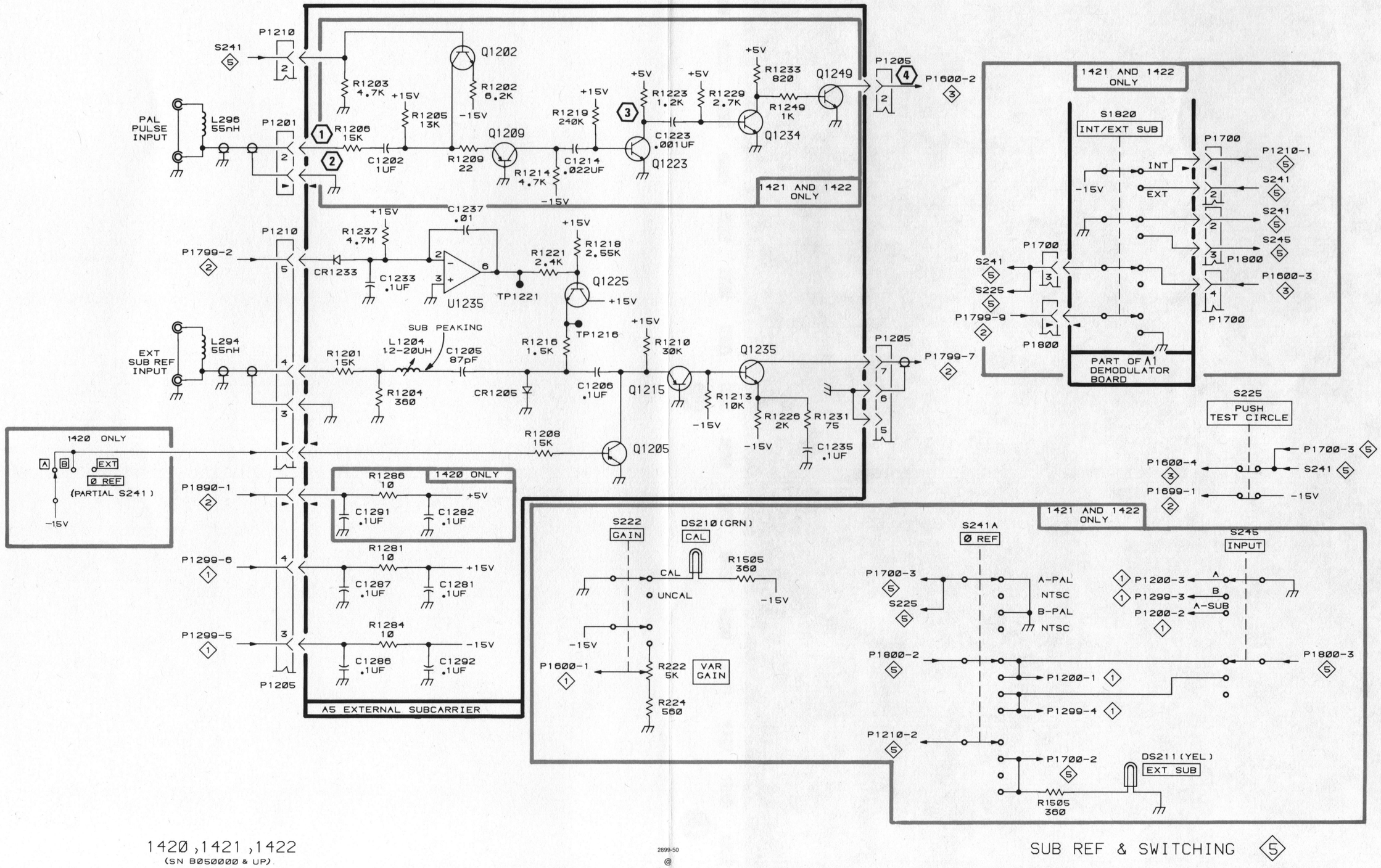
DC COUPLED

4



DC COUPLED

2899-65



1420, 1421, 1422
(SN B050000 & UP)

SUB REF & SWITCHING 5

REPLACEABLE MECHANICAL PARTS

PARTS ORDERING INFORMATION

Replacement parts are available from or through your local Tektronix, Inc. Field Office or representative.

Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available, and to give you the benefit of the latest circuit improvements developed in our engineering department. It is therefore important, when ordering parts, to include the following information in your order: Part number, instrument type or number, serial number, and modification number if applicable.

If a part you have ordered has been replaced with a new or improved part, your local Tektronix, Inc. Field Office or representative will contact you concerning any change in part number.

Change information, if any, is located at the rear of this manual.

SPECIAL NOTES AND SYMBOLS

X000	Part first added at this serial number
00X	Part removed after this serial number

FIGURE AND INDEX NUMBERS

Items in this section are referenced by figure and index numbers to the illustrations.

INDENTATION SYSTEM

This mechanical parts list is indented to indicate item relationships. Following is an example of the indentation system used in the description column.

1 2 3 4 5 Name & Description

Assembly and/or Component
Attaching parts for Assembly and/or Component
- - - * - - -
Detail Part of Assembly and/or Component
Attaching parts for Detail Part
- - - * - - -
Parts of Detail Part
Attaching parts for Parts of Detail Part
- - - * - - -

Attaching Parts always appear in the same indentation as the item it mounts, while the detail parts are indented to the right. Indented items are part of, and included with, the next higher indentation. The separation symbol - - - * - - - indicates the end of attaching parts.

Attaching parts must be purchased separately, unless otherwise specified.

ITEM NAME

In the Parts List, an Item Name is separated from the description by a colon (:). Because of space limitations, an Item Name may sometimes appear as incomplete. For further Item Name identification, the U.S. Federal Cataloging Handbook H6-1 can be utilized where possible.

ABBREVIATIONS

"	INCH
#	NUMBER SIZE
ACTR	ACTUATOR
ADPTR	ADAPTER
ALIGN	ALIGNMENT
AL	ALUMINUM
ASSEM	ASSEMBLED
ASSY	ASSEMBLY
ATTEN	ATTENUATOR
AWG	AMERICAN WIRE GAGE
BD	BOARD
BRKT	BRACKET
BRS	BRASS
BRZ	BRONZE
BSHG	BUSHING
CAB	CABINET
CAP	CAPACITOR
CER	CERAMIC
CHAS	CHASSIS
CKT	CIRCUIT
COMP	COMPOSITION
CONN	CONNECTOR
COV	COVER
CPLG	COUPLING
CRT	CATHODE RAY TUBE
DEG	DEGREE
DWR	DRAWER
ELCTRN	ELECTRON
ELEC	ELECTRICAL
ELCTLT	ELECTROLYTIC
ELEM	ELEMENT
EPL	ELECTRICAL PARTS LIST
EQPT	EQUIPMENT
EXT	EXTERNAL
FIL	FILLISTER HEAD
FLEX	FLEXIBLE
FLH	FLAT HEAD
FLTR	FILTER
FR	FRAME or FRONT
FSTNR	FASTENER
FT	FOOT
FXD	FIXED
GSKT	GASKET
HDL	HANDLE
HEX	HEXAGON
HEX HD	HEXAGONAL HEAD
HEX SOC	HEXAGONAL SOCKET
HLCPS	HELICAL COMPRESSION
HLEXT	HELICAL EXTENSION
HV	HIGH VOLTAGE
IC	INTEGRATED CIRCUIT
ID	INSIDE DIAMETER
IDENT	IDENTIFICATION
IMPLR	IMPELLER
IN	INCH
INCAND	INCANDESCENT
INSUL	INSULATOR
INTL	INTERNAL
LPHLDR	LAMPHOLDER
MACH	MACHINE
MECH	MECHANICAL
MTG	MOUNTING
NIP	NIPPLE
NON WIRE	NOT WIRE WOUND
OBD	ORDER BY DESCRIPTION
OD	OUTSIDE DIAMETER
OVH	OVAL HEAD
PH BRZ	PHOSPHOR BRONZE
PL	PLAIN or PLATE
PLSTC	PLASTIC
PN	PART NUMBER
PNH	PAN HEAD
PWR	POWER
RCPT	RECEPTACLE
RES	RESISTOR
RGD	RIGID
RLF	RELIEF
RTNR	RETAINER
SCH	SOCKET HEAD
SCOPE	OSCILLOSCOPE
SCR	SCREW
SE	SINGLE END
SECT	SECTION
SEMICOND	SEMICONDUCTOR
SHLD	SHIELD
SHLDR	SHOULDERED
SKT	SOCKET
SL	SLIDE
SLFLKG	SELF-LOCKING
SLVG	SLEEVING
SPR	SPRING
SQ	SQUARE
SST	STAINLESS STEEL
STL	STEEL
SW	SWITCH
T	TUBE
TERM	TERMINAL
THD	THREAD
THK	THICK
TNSN	TENSION
TPG	TAPPING
TRH	TRUSS HEAD
V	VOLTAGE
VAR	VARIABLE
W/	WITH
WSHR	WASHER
XFMR	TRANSFORMER
XSTR	TRANSISTOR

CROSS INDEX—MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip
000CY	NORTHWEST FASTENER SALES, INC.	7923 SW CIRRUS DRIVE	BEAVERTON, OREGON 97005
00779	AMP, INC.	P O BOX 3608	HARRISBURG, PA 17105
00866	GOE ENGINEERING COMPANY, INC.	P O BOX 3485, 250 S 9TH AVE.	CITY OF INDUSTRY, CA 91746
01295	TEXAS INSTRUMENTS, INC., SEMICONDUCTOR GROUP	P O BOX 5012, 13500 N CENTRAL EXPRESSWAY	DALLAS, TX 75222
04713	MOTOROLA, INC., SEMICONDUCTOR PROD. DIV.	5005 E MCDOWELL RD,PO BOX 20923	PHOENIX, AZ 85036
12136	PHILADELPHIA HANDLE COMPANY, INC.	1643 HADDON AVENUE	CAMDEN, NJ 08103
12327	FREEWAY CORPORATION	9301 ALLEN DRIVE	CLEVELAND, OH 44125
13511	AMPHENOL CARDRE DIV., BUNKER RAMO CORP.		LOS GATOS, CA 95030
22526	BERG ELECTRONICS, INC.	YOUK EXPRESSWAY	NEW CUMBERLAND, PA 17070
28520	HEYMAN MFG. CO.	147 N. MICHIGAN AVE.	KENILWORTH, NJ 07033
49671	RCA CORPORATION	30 ROCKEFELLER PLAZA	NEW YORK, NY 10020
55292	LEDCO DIV., WILBRECHT ELECTRONICS, INC.	240 EAST PLATO BLVD.	ST. PAUL, MN 55107
70318	ALLMETAL SCREW PRODUCTS CO., INC.	821 STEWART AVE.	GARDEN CITY, NY 11530
70485	ATLANTIC INDIA RUBBER WORKS, INC.	571 W. POLK ST.	CHICAGO, IL 60607
71785	TRW, CINCH CONNECTORS	1501 MORSE AVENUE	ELK GROVE VILLAGE, IL 60007
73743	FISCHER SPECIAL MFG. CO.	446 MORGAN ST.	CINCINNATI, OH 45206
73803	TEXAS INSTRUMENTS, INC., METALLURGICAL MATERIALS DIV.	34 FOREST STREET	ATTLEBORO, MA 02703
74921	ITEN FIBRE CO.,	4001 BENEFIT AVE., P O BOX 9	ASHTABULA, OH 44004
75915	LITTELFUSE, INC.	800 E. NORTHWEST HWY	DES PLAINES, IL 60016
77250	PHEOLL MANUFACTURING CO., DIVISION OF ALLIED PRODUCTS CORP.	5700 W. ROOSEVELT RD.	CHICAGO, IL 60650
78189	ILLINOIS TOOL WORKS, INC. SHAKEPROOF DIVISION	ST. CHARLES ROAD	ELGIN, IL 60120
79807	WROUGHT WASHER MFG. CO.	2100 S. O BAY ST.	MILWAUKEE, WI 53207
80009	TEKTRONIX, INC.	P O BOX 500	BEAVERTON, OR 97077
80033	PRESTOLE EVERLOCK, INC.	P. O. BOX 278,1345 MIAMI ST.	TOLEDO, OH 43605
80112	G. C. ELECTRONICS COMPANY, A DIVISION OF HYDROMETALS, INC.	3225 EXPOSITION PLACE	LOS ANGELES, CA 90018
83385	CENTRAL SCREW CO.	2530 CRESCENT DR.	BROADVIEW, IL 60153
85471	BOYD, A. B., CO.	2527 GRANT AVENUE	SAN LEANDRO, CA 94579
86445	PENN FIBRE AND SPECIALTY CO., INC.	2032 E. WESTMORELAND ST.	PHILADELPHIA, PA 19134
86928	SEASTROM MFG. COMPANY, INC.	701 SONORA AVENUE	GLENDALE, CA 91201
90484	ITT, SURPRENANT DIV.	172 STERLING STREET	CLINTON, MA 01510
96904	NATVAR CORP.	211 RANDOLPH AVE.	WOODBRIDGE, NJ 07095
98278	MALCO A MICRODOT COMPANY, INC. CONNECTOR AND CABLE DIVISION	220 PASADENA AVE.	SOUTH PASADENA, CA 91030

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
1-1	390-0018-01			1		CAB.,ELEC EQUIP:	80009	390-0018-01
	----- -----			-		(OPTION 2 ONLY)		
	437-0100-01			1		CAB.,ELEC EQUIP:(NOT SHOWN)	80009	437-0100-01
						(ATTACHING PARTS)		
-2	212-0033-00			2		SCREW,MACHINE:8-32 X 0.750 INCH,PNH STL	83385	OBD
	----- -----			-		(OPTION 2 ONLY)		
						- - - * - - -		
	----- -----			-		. CABINET INCLUDES:		
-3	105-0074-00			1		. STRIKE,CATCH:REAR,INSTR SECRG,ACETAL	80009	105-0074-00
	----- -----			-		. (OPTION 2 ONLY)		
						(ATTACHING PARTS)		
-4	210-0457-00			2		. NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL	83385	OBD
	----- -----			-		. (OPTION 2 ONLY)		
						- - - * - - -		
-5	348-0187-00			4		. FOOT,CABINET:0.780 X 1.650 INCH LONG	80009	348-0187-00
	----- -----			-		. (OPTION 2 ONLY)		
						(ATTACHING PARTS)		
-6	211-0503-00			4		. SCREW,MACHINE:6-32 X 0.188 INCH,PNH STL	83385	OBD
	----- -----			-		. (OPTION 2 ONLY)		
						- - - * - - -		
-7	344-0098-00			2		. CLIP,DECORATIVE:CARRYING HANDLE,STL NP	12136	OBD
	----- -----			-		. (OPTION 2 ONLY)		
-8	367-0037-00			1		. HANDLE,CARRYING:	80009	367-0037-00
	----- -----			-		. (OPTION 2 ONLY)		
						(ATTACHING PARTS)		
-9	213-0155-00			2		. SCREW,MACHINE:10-32 X 0.40 INCH LONG,STL	77250	OBD
	----- -----			-		. (OPTION 2 ONLY)		
						- - - * - - -		
-10	331-0192-00			1		MASK,CRT SCALE:	80009	331-0192-00
-11	337-2501-00			1		SHLD,IMPLOSION:5.165 L X 4.685 W,CLEAR	80009	337-2501-00
	378-0586-00			1		FILTER,LT,CRT:SMK GY,5.165 X 4.685 X 0.03	80009	378-0586-00
						(ATTACHING PARTS)		
-12	211-0097-00			4		SCREW,MACHINE:4-40 X 0.312 INCH,PNH STL	83385	OBD
						- - - * - - -		
-13	366-0496-00			1		KNOB:W/SETSCREW	80009	366-0496-00
	213-0153-00			2		. SETSCREW:5-40 X 0.125,STL BK OXD,HEX	000CY	OBD
-14	366-1283-00			1		KNOB:GRAY	80009	366-1283-00
	213-0153-00			1		. SETSCREW:5-40 X 0.125,STL BK OXD,HEX	000CY	OBD
-15	366-1541-00			1		PUSH BUTTON:TEST CIRCLE	80009	366-1541-00
-16	366-0215-02			2		KNOB:LEVER SWITCH	80009	366-0215-02
-17	366-1035-02			4		KNOB:FRICT MT,W/SPRING & SKIRT	80009	366-1035-02
-18	333-1871-01			1		PANEL,FRONT:RIGHT	80009	333-1871-01
	----- -----			-		(1420 ONLY)		
	333-1872-01	B050000	B051269	1		PANEL,FRONT:RIGHT	80009	333-1872-01
	----- -----			-		(1421 ONLY)		
	333-1872-02	B051270		1		PANEL,FRONT:RIGHT	80009	333-1872-02
	----- -----			-		(1421 ONLY)		
	333-1873-01	B050000	B050198	1		PANEL,FRONT:RIGHT	80009	333-1873-01
	----- -----			-		(1422 ONLY)		
	333-1873-02	B050199		1		PANEL,FRONT:RIGHT	80009	333-1873-02
	----- -----			-		(1422 ONLY)		
						(ATTACHING PARTS)		
-19	211-0008-00			2		SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
						- - - * - - -		
-20	333-2100-00	B050000	B053194	1		PANEL,FRONT:LEFT	80009	333-2100-00
	----- -----			-		(1420 ONLY)		
	333-2100-01	B053195		1		PANEL,FRONT:LEFT	80009	333-2100-01
	----- -----			-		(1420 ONLY)		
	333-1899-01			1		PANEL,FRONT:LEFT	80009	333-1899-01
	----- -----			-		(1421 AND 1422 ONLY)		
						(ATTACHING PARTS)		
-21	211-0008-00			2		SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
						- - - * - - -		
	384-0337-00			1		EXTENSION SHAFT:6.016 L X 0.125 OD SST	80009	384-0337-00
	----- -----			-		(1421,1422 ONLY)		

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
-1	348-0031-00			1		GROMMET,PLASTIC:0.156 INCH DIA	80009	348-0031-00
	----- -----			-		(1421,1422 ONLY)		
	384-0338-00			1		EXTENSION SHAFT:6.016 L X 0.15 OD W/KNOB	80009	384-0338-00
	----- -----			-		(1421,1422 ONLY)		
-22	386-1304-14			1		SUBPANEL,FRONT:	80009	386-1304-14
	----- -----			-		(1421 AND 1422 ONLY)		
						(ATTACHING PARTS)		
-23	129-0462-00			2		POST,ELEC-MECH:0.312 OD X 0.885 INCH LONG	80009	129-0462-00
-24	210-0458-00			2		NUT,PLAIN,EXT W:8-32 X 0.344 INCH,STL	83385	OBD
						- - - * - - -		
-25	354-0327-00			1		MOUNT,RESILIENT:CRT DELRIN	80009	354-0327-00
						(ATTACHING PARTS)		
-26	211-0590-00			3		SCREW,MACHINE:6-32 X 0.25 INCH,PNH STL	83385	OBD
						- - - * - - -		
-27	----- -----			4		RES.,VAR:(SEE R410,R420,R430,R440 EPL)		
						(ATTACHING PARTS)		
-28	210-0583-00			4		NUT,PLAIN,HEX.:0.25-32 X 0.312 INCH,BRS	73743	2X20224-402
-29	210-0940-00			4		WASHER,FLAT:0.25 ID X 0.375 INCH OD,STL	79807	OBD
-30	210-0046-00			4		WASHER,LOCK:INTL,0.26 ID X 0.40" OD,STL	78189	4214-05-00-0541C
						- - - * - - -		
-31	200-0608-00			2		COVER,VAR RES.:PLASTIC	80009	200-0608-00
	----- -----			1		VAR.,POT:(SEE R445,S445 EPL)		
-32	366-1189-00			1		KNOB:GRAY	80009	366-1189-00
						(ATTACHING PARTS)		
-33	210-0583-00			1		NUT,PLAIN,HEX.:0.25-32 X 0.312 INCH,BRS	73743	2X20224-402
-34	210-0940-00			1		WASHER,FLAT:0.25 ID X 0.375 INCH OD,STL	79807	OBD
-35	210-0562-00			1		NUT,PLAIN,HEX.:0.25-40 X 0.312 INCH,BBS	73743	2X20224-402
						- - - * - - -		
-36	----- -----			1		RES.,VAR:(SEE R222 EPL)		
						(ATTACHING PARTS)		
-37	210-0583-00			1		NUT,PLAIN,HEX.:0.25-32 X 0.312 INCH,BRS	73743	2X20224-402
-38	210-0940-00			1		WASHER,FLAT:0.25 ID X 0.375 INCH OD,STL	79807	OBD
	210-0807-00			1		WASHER,FLAT:0.310 ID X 0.630 OD	12327	OBD
	210-1302-00	XB052800		1		WASHER,FLAT:0.343 ID X 0.1 THK,0.718 OD	86928	A379-95
						- - - * - - -		
-39	----- -----			1		GONIOMETER,ELEC:(SEE T230 EPL)		
						(ATTACHING PARTS)		
-40	210-0580-00			1		NUT,PLAIN,HEX.:0.312-32 X 0.474 INCH,BRS	73743	OBD
-41	210-1025-00			1		WASHER,FLAT:0.312 ID X 0.469 OD,BRS	12327	OBD
	210-1302-00	XB052800		1		WASHER,FLAT:0.343 ID X 0.1 THK,0.718 OD	86928	A379-95
						- - - * - - -		
-42	----- -----			2		SWITCH,LEVER:(SEE S241,S245 EPL)		
						(ATTACHING PARTS)		
-43	220-0413-00			4		NUT,SLEEVE:4-40 X 0.562 INCH LONG	80009	220-0413-00
						- - - * - - -		
-44	150-0123-03			1		LAMP,CARTRIDGE:14V,23MA	55292	71523-02
-45	150-0123-01			1		LAMP,CARTRIDGE:14V,0.023A,YELLOW LENS	55292	71326-06
	210-1302-00	XB052800		1		WASHER,FLAT:0.343 ID X 0.1 THK,0.718 OD	86928	A379-95
	----- -----			-		(1420 ONLY)		
	210-1302-00	XB051402		1		WASHER,FLAT:0.343 ID X 0.1 THK,0.718 OD	86928	A379-95
	----- -----			-		(1421 ONLY)		
	210-1302-00	XB050199		1		WASHER,FLAT:0.343 ID X 0.1 THK,0.718 OD	86928	A379-95
	----- -----			-		(1422 ONLY)		
	210-1303-00	XB052800		1		WASHER,FLAT:0.281 ID X 0.1 THK,AL	86928	OBD
	----- -----			-		(1420 ONLY)		
	210-1303-00	XB051402		1		WASHER,FLAT:0.281 ID X 0.1 THK,AL	86928	OBD
	----- -----			-		(1421 ONLY)		
	210-1303-00	XB050199		1		WASHER,FLAT:0.281 ID X 0.1 THK,AL	86928	OBD
	----- -----			-		(1422 ONLY)		
-46	441-0784-01			1		CHAS,ELEC EQUIP:	80009	441-0784-01
-47	255-0249-00			FT		PLASTIC CHANNEL:	80009	255-0249-00
-48	214-1696-00			2		PIN,GUIDE:0.50 INCH LONG	80009	214-1696-00
						(ATTACHING PARTS)		
-49	211-0504-00			2		SCREW,MACHINE:6-32 X 0.25 INCH,PNH STL	83385	OBD
						- - - * - - -		

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
1-50	343-0088-00			4		CLAMP,LOOP:0.062 INCH DIA	80009	343-0088-00
-51	386-1398-00			1		SUPPORT,CHAS:ALUMINUM	80009	386-1398-00
						(ATTACHING PARTS)		
-52	211-0504-00			3		SCREW,MACHINE:6-32 X 0.25 INCH,PNH STL	83385	OBD
						- - - * - - -		
-53	252-0564-00			FT		PLASTIC EXTR:1.563 FT LONG	80009	252-0564-00
-54	348-0063-00			5		GROMMET,PLASTIC:0.50 INCH DIA	80009	348-0063-00
-55	348-0031-00			2		GROMMET,PLASTIC:0.156 INCH DIA	80009	348-0031-00
-56	210-0201-00			2		TERMINAL,LUG:SE #4	86928	A373-157-2
						(ATTACHING PARTS)		
-57	211-0008-00			2		SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
-58	210-0586-00			2		NUT,PLAIN,EXT W:4-40 X 0.25 INCH,STL	78189	211-041800-00
						- - - * - - -		
-59	129-0208-00			2		SPACER,POST:0.312" LONG,6-32 ONE END	80009	129-0208-00
						(ATTACHING PARTS)		
-60	210-0586-00			2		NUT,PLAIN,EXT W:4-40 X 0.25 INCH,STL	78189	211-041800-00
-61	211-0590-00			2		SCREW,MACHINE:6-32 X 0.25 INCH,PNH STL	83385	OBD
						- - - * - - -		
-62	210-0202-00			1		TERMINAL,LUG:0.146 ID,LOCKING,BRZ TINNED	78189	2104-06-00-2520N
						(ATTACHING PARTS)		
-63	210-0457-00			1		NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL	83385	OBD
						- - - * - - -		
-64	344-0133-00			4		CLIP,SPR,TNSN:CIRCUIT CARD MOUNTING	80009	344-0133-00
						(ATTACHING PARTS)		
-65	213-0138-00			4		SCR,TPG,THD FOR:4-40 X 0.188 INCH,PNH STL	83385	OBD
						- - - * - - -		
-66	441-1305-00			1		CHASSIS,MONITOR:POWER	80009	441-1305-00
-67	----- -----			1		TRANSISTOR:(SEE Q590 EPL)		
						(ATTACHING PARTS)		
-68	210-1178-00			1		WSHR,SHOULDERED:FOR MTG TO-220 TRANSISTOR	49671	DF 137A
-69	342-0202-00			1		INSULATOR,PLATE:TRANSISTOR	01295	10-21-023-106
-70	211-0097-00			1		SCREW,MACHINE:4-40 X 0.312 INCH,PNH STL	83385	OBD
	210-0586-00			1		NUT,PLAIN,EXT W:4-40 X 0.25 INCH,STL	78189	211-041800-00
						- - - * - - -		
-71	210-0202-00			1		TERMINAL,LUG:0.146 ID,LOCKING,BRZ TINNED	78189	2104-06-00-2520N
						(ATTACHING PARTS)		
-72	211-0504-00			1		SCREW,MACHINE:6-32 X 0.25 INCH,PNH STL	83385	OBD
-73	210-0457-00			1		NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL	83385	OBD
						- - - * - - -		
-74	129-0006-00			1		TERMINAL,STUD:INSULATED	00866	1700P
						(ATTACHING PARTS)		
-75	210-0457-00			1		NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL	83385	OBD
						- - - * - - -		
-76	----- -----			1		TRANSISTOR:(SEE Q430 EPL)		
						(ATTACHING PARTS)		
-77	387-0345-00			1		INSULATOR,PLATE:ANODIZED ALUMINUM	80009	387-0345-00
-78	211-0511-00			2		SCREW,MACHINE:6-32 X 0.50 INCH,PNH STL	83385	OBD
-79	210-0457-00			2		NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL	83385	OBD
-80	210-0202-00			1		TERMINAL,LUG:0.146 ID,LOCKING,BRZ TINNED	78189	2104-06-00-2520N
-81	210-0935-00			2		WASHER,NONMETAL:FIBER,0.14 IDX 0.375"OD	74921	OBD
-82	210-0803-00			2		WASHER,FLAT:0.15 ID X 0.032 THK,STL CD PL	12327	OBD
						- - - * - - -		
-83	----- -----			1		TRANSISTOR:(SEE Q428 EPL)		
						(ATTACHING PARTS)		
-84	211-0038-00			1		SCREW,MACHINE:4-40 X 0.312"100 DEG,FLH STL	83385	OBD
-85	210-0586-00			1		NUT,PLAIN,EXT W:4-40 X 0.25 INCH,STL	78189	211-041800-00
						- - - * - - -		
-86	----- -----			2		TRANSISTOR:(SEE Q425,Q427 EPL)		
						(ATTACHING PARTS)		
-87	342-0163-00			2		INSULATOR,PLATE:XSTR,0.675 X 0.625 X 0.001"	80009	342-0163-00
-88	211-0038-00			2		SCREW,MACHINE:4-40 X 0.312"100 DEG,FLH STL	83385	OBD
-89	210-1122-00			2		WASHER,LOCK:0.228 ID X 0.375 INCH OD,STL	04713	B52200F006
-90	210-0406-00			2		NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS	73743	2X12161-402
						- - - * - - -		

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
1-91	----- -----			1		TRANSFORMER:(SEE T430 EPL)		
						(ATTACHING PARTS)		
-92	212-0590-00			4		SCREW,MACHINE:10-32 X 1.50 INCH HEX STL	83385	OBD
-93	220-0410-00			4		NUT,EXTENDED WA:10-32 X 0.375 INCH,STL	83385	OBD
-94	166-0432-00			4		INS SLV,ELEC:BOLT INSULATING	80009	166-0432-00
-95	210-0812-00			4		WASHER,NONMETAL:#10,FIBER	86445	OBD
						- - - * - - -		
-96	344-0117-00			1		RTNR,CAPACITOR:CAPACITOR MTG	80033	E50005-041
						(ATTACHING PARTS)		
-97	211-0097-00			1		SCREW,MACHINE:4-40 X 0.312 INCH,PNH STL	83385	OBD
-98	210-0586-00			1		NUT,PLAIN,EXT W:4-40 X 0.25 INCH,STL	78189	211-041800-00
						- - - * - - -		
-99	337-1011-01			1		SHLD,ELECTRON:	80009	337-1011-01
-100	136-0273-00			2		LAMPHOLDER:FOR GROOVED BASE	80009	136-0273-00
						(ATTACHING PARTS)		
-101	211-0590-00			3		SCREW,MACHINE:6-32 X 0.25 INCH,PNH STL	83385	OBD
-102	220-0502-00	XB050000		1		NUT STRIP:3.0 X 0.375 X 0.125,W/3 6-3	80009	220-0502-00
						- - - * - - -		
-103	337-1013-01			2		SHIELD,LIGHT:	80009	337-1013-01
-104	378-0114-00			1		DIFFUSER,LIGHT:CLEAR,PLASTIC	80009	378-0114-00
-105	352-0142-00			1		HOLDER,LT CNDCT:DELRIN	80009	352-0142-00
-106	348-0145-00			1		GROMMET,PLASTIC:U-SHP,1.0 X 0.42 INCH	80009	348-0145-00
-107	348-0090-00			4		CUSHION,CRT:	85471	OBD
-108	136-0202-01			1		SOCKET,PLUG-IN:14 PIN	80009	136-0202-01
-109	200-0616-00			1		COVER,CRT SKT:1.78 DIA X 0.2 D,WHITE	80009	200-0616-00
-110	343-0124-00			1		CLAMP,LOOP:ELECTRON TUBE RETAINER	80009	343-0124-00
-111	352-0091-01			2		RTNR,LOOP CLAMP:ELECTRON TUBE	80009	352-0091-01
						(ATTACHING PARTS)		
-112	211-0599-00			1		SCREW,MACHINE:6-32 X 0.750 INCH,FIL SST	83385	OBD
-113	210-1092-00			2		WASHER,FLAT:0.147 ID X 0.312" OD,BRS	12327	OBD
-114	220-0444-00			1		NUT,PLAIN,SQ:6-32 X 0.250 INCH,STL	70318	OBD
						- - - * - - -		
-115	343-0123-01			2		CLAMP,RET.,ELEC:CRT,REAR	80009	343-0123-01
						(ATTACHING PARTS)		
-116	211-0600-00			2		SCREW,MACHINE:6-32 X 2 INCH,FIL SST	83385	OBD
	210-1092-00			4		WASHER,FLAT:0.147 ID X 0.312" OD,BRS	12327	OBD
-117	220-0444-00			2		NUT,PLAIN,SQ:6-32 X 0.250 INCH,STL	70318	OBD
-118	211-0590-00			4		SCREW,MACHINE:6-32 X 0.25 INCH,PNH STL	83385	OBD
						- - - * - - -		
-119	333-2101-00			1		PANEL,REAR:	80009	333-2101-00
						(ATTACHING PARTS)		
-120	212-0001-00			1		SCREW,MACHINE:8-32 X 0.250 INCH,PNH STL	77250	OBD
	212-0004-00	B050000	B054219	2		SCREW,MACHINE:8-32 X 0.312 INCH,PNH STL	83385	OBD
	----- -----			-		(1420 ONLY)		
	212-0023-00	B054220		2		SCREW,MACHINE:8-32 X 0.375 INCH,PNH STL	83385	OBD
	----- -----			-		(1420 ONLY)		
	212-0004-00	B010100	B051529	2		SCREW,MACHINE:8-32 X 0.312 INCH,PNH STL	83385	OBD
	----- -----			-		(1421 ONLY)		
	212-0023-00	B051530		2		SCREW,MACHINE:8-32 X 0.375 INCH,PNH STL	83385	OBD
	----- -----			-		(1421 ONLY)		
	212-0004-00	B010100	B050209	2		SCREW,MACHINE:8-32 X 0.312 INCH,PNH STL	83385	OBD
	----- -----			-		(1422 ONLY)		
	212-0023-00	B050210		2		SCREW,MACHINE:8-32 X 0.375 INCH,PNH STL	83385	OBD
	----- -----			-		(1422 ONLY)		
	210-0458-00			2		NUT,PLAIN,EXT W:8-32 X 0.344 INCH,STL	83385	OBD
						- - - * - - -		
-121	134-0026-00			2		BUTTON,PLUG:FOR 0.375" HOLE	80112	1711-M
	----- -----			-		(OPTION 2 ONLY)		
-122	131-0955-00			6		CONNECTOR,RCPT,:BNC,FEMALE,W/HARDWARE	13511	31-279
	----- -----			-		(OPTION 2 ONLY)		
	131-0955-00			8		CONNECTOR,RCPT,:BNC,FEMALE,W/HARDWARE	13511	31-279
	----- -----			-		(1420 ONLY)		
-123	337-2121-00			1		SHIELD,ELEC:LOOP THRU	80009	337-2121-00
-124	352-0362-00			1		FUSEHOLDER: W/MOUNTING HARDWARE	75915	345001
						(ATTACHING PARTS)		
-125	210-0873-00			1		WASHER,NONMETAL:0.5 ID X 0.688 INCH OD,NPRN	70485	OBD
						- - - * - - -		

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Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
1-126	200-0237-01			1		COVER,FUSE HLDR:BLACK PLASTIC	80009	200-0237-01
-127	334-0904-01			1		PL,INSTRUCTION:	80009	334-0904-01
						(ATTACHING PARTS)		
-128	213-0088-00			2		SCR,TPG,THD CTG:4-24 X 0.25 INCH,PNH STL	83385	OBD
						- - - * - - -		
-129	200-0777-00			1		COV,ACCESS,CRT:	80009	200-0777-00
-130	358-0161-00			1		BSHG,STRAIN RLF:FOR 0.50 INCH HOLE,PLASTIC	28520	SR5P4
-131	161-0049-00			1		CABLE ASSY,PWR,:80 INCH LONG,W/MALE CONN	80009	161-0049-00
-132	----- -----			1		CKT BOARD ASSY:DEMODULATOR(SEE A1 EPL)		
						(ATTACHING PARTS)		
-133	211-0116-00			4		SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH BRS	83385	OBD
-134	129-0354-00			2		POST,ELEC-MECH:0.54 " LONG X 0.188 ",HEX	80009	129-0354-00
						- - - * - - -		
	----- -----			-		. CKT BOARD ASSY:INCLUDES:		
-135	131-0589-00			23		. TERM,PIN:0.46 L X 0.025 SQ.PH BRZ GL	22526	47350
-136	136-0183-00			1		. SOCKET,PLUG-IN:3 PIN,ROUND	80009	136-0183-00
-137	136-0220-00			53		. SOCKET,PLUG-IN:3 PIN,SQUARE	71785	133-23-11-034
-138	136-0235-00			1		. SOCKET,PLUG-IN:6 CONTACT,ROUND	71785	133-96-12-062
-139	136-0237-00			2		. SOCKET,PLUG-IN:8 CONTACT,ROUND	71785	133-98-12-062
-140	136-0241-00			2		. SOCKET,PLUG-IN:10 CONTACT,ROUND	71785	133-99-12-064
-141	136-0220-04			14		. SOCKET,PIN TERM:0.188 INCH LONG	22526	75060
-142	136-0263-04			1		. SOCKET,PIN TERM:FOR 0.025 INCH SQUARE PIN	22526	48059
-143	136-0269-02			1		. SOCKET,PLUG-IN:14 CONTACT,LOW CLEARANCE	01295	C95140
-144	136-0514-00			2		. SOCKET,PLUG IN:MICROCIRCUIT,8 CONTACT	73803	CS9002-8
-145	136-0234-00	B050000	B052959	2		. SOCKET,PIN TERM:0.088 OD X 0.247 INCH L	00779	380598-1
	136-0674-00	B052960		1		. SKT,PIN TERM.:FOR 0.048 DIA PIN	00779	1-380758-0
	136-0234-00	B050000	B051174	1		. SOCKET,PIN TERM:0.088 OD X 0.247 INCH L	00779	380598-1
	136-0674-00	B051175		1		. SKT,PIN TERM.:FOR 0.048 DIA PIN	00779	1-380758-0
	136-0234-00	B050000	B050280	1		. SOCKET,PIN TERM:0.088 OD X 0.247 INCH L	00779	380598-1
	136-0674-00	B050281		1		. SKT,PIN TERM.:FOR 0.048 DIA PIN	00779	1-380758-0
-146	352-0096-00			1		. CLIP,SPR,TNSN:CRYSTAL	80009	352-0096-00
-147	352-0134-00			1		. HOLDER,COIL:TOROIDAL,0.472 X 0.417 INCH	80009	352-0134-00
-148	214-0506-00			1		. CONTACT,ELEC:0.045 SQ X 0.375 INCH L	80009	214-0506-00
-149	214-0579-00			24		. TERM,TEST POINT:BRS CD PL	80009	214-0579-00
-150	337-1417-00			2		. SHLD,ELECTRICAL:0.55 SQ X 0.685 INCH HIGH	80009	337-1417-00
-151	----- -----			-		CKT BOARD ASSY:INPUT AMPL(SEE A4 EPL)		
						(ATTACHING PARTS)		
-152	211-0116-00			2		SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH BRS	83385	OBD
						- - - * - - -		
	----- -----			-		. CKT BOARD ASSY INCLUDES:		
-153	131-0591-00			1		. CONTACT,ELEC:0.835 INCH LONG	22526	47352
-154	337-1197-02			1		. SHIELD,ELEC:2.300 X 0.400 INCH	80009	337-1197-02
-155	----- -----			1		CKT BOARD ASSY:DEFLECTION(SEE A2 EPL)		
	214-1208-00			4		. CKT BOARD ASSY INCLUDES:		
-156	214-1208-00			4		. CKT BOARD ASSY INCLUDES:		
-157	131-0589-00			9		. TERM,PIN:0.46 L X 0.025 SQ.PH BRZ GL	22526	47350
-158	136-0183-00			4		. SOCKET,PLUG-IN:3 PIN,ROUND	80009	136-0183-00
-159	136-0235-00			1		. SOCKET,PLUG-IN:6 CONTACT,ROUND	71785	133-96-12-062
-160	----- -----			-		CKT BOARD ASSY:EXTERNAL SUBCARRIER(SEE A5 EPL)		
-161	131-0998-00			1		. BUS BAR:9 TERM,8.132"LONG,CUT TO FIT	80009	131-0998-00
-162	131-0589-00			14		. TERM,PIN:0.46 L X 0.025 SQ.PH BRZ GL	22526	47350
-163	131-0998-00			2		. BUS BAR:9 TERM,8.132"LONG,CUT TO FIT	80009	131-0998-00
-164	136-0220-00			4		. SOCKET,PLUG-IN:3 PIN,SQUARE	71785	133-23-11-034
	136-0220-00			9		. SOCKET,PLUG-IN:3 PIN,SQUARE	71785	133-23-11-034
-165	136-0514-00			1		. SOCKET,PLUG IN:MICROCIRCUIT,8 CONTACT	73803	CS9002-8
-166	214-0579-00			2		. TERM,TEST POINT:BRS CD PL	80009	214-0579-00
-167	337-1456-00			1		. SHLD,ELECTRICAL:CKT CARD MOUNT	80009	337-1456-00
-168	----- -----			1		CKT BOARD ASSY:POWER SUPPLY(SEE A3 EPL)		
						(ATTACHING PARTS)		
-169	211-0116-00			6		SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH BRS	83385	OBD
						- - - * - - -		
	----- -----			-		. CKT BOARD ASSY INCLUDES:		
-170	131-0589-00			46		. TERM,PIN:0.46 L X 0.025 SQ.PH BRZ GL	22526	47350
-171	136-0220-00			7		. SOCKET,PLUG-IN:3 PIN,SQUARE	71785	133-23-11-034
-172	214-0579-00			7		. TERM,TEST POINT:BRS CD PL	80009	214-0579-00

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Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
1-173	131-1683-00			1		LINK,TERM CONN:BROWN,1-2,4-5	80009	131-1683-00
-174	131-1684-00			1		LINK,TERM CONN:RED,1-5	80009	131-1684-00
-175	131-0883-00			4		CONTACT,ELEC:CRT	98278	101-001-019
-176	175-0529-00			FT		WIRE,ELECTRICAL:26 AWG	90484	OBD
-177	179-2257-02			1		WIRING HARNESS,:CHASSIS	80009	179-2257-02
	----- -----			-		(OPTION 2 ONLY)		
-178	131-0621-00			40		. CONNECTOR,TERM:22-26 AWG,BRS& CU BE GOLD	22526	46231
-179	131-0707-00			6		. CONNECTOR,TERM.:22-26 AWG,BRS& CU BE GOLD	22526	47439
-180	352-0200-00			1		. HLDR,TERM CONN:4 WIRE BLACK	80009	352-0200-00
-181	352-0161-00			5		. HLDR,TERM CONN:3 WIRE BLACK	80009	352-0161-00
-182	352-0204-00			4		. CONN BODY,PL,EL:8 WIRE BLACK	80009	352-0204-00
	352-0200-00			2		HLDR,TERM CONN:4 WIRE BLACK	80009	352-0200-00
-183	179-2270-02			1		WIRING HARNESS,:CHASSIS	80009	179-2270-02
	352-0161-00			3		. HLDR,TERM CONN:3 WIRE BLACK	80009	352-0161-00
-184	352-0198-00			2		. HLDR,TERM CONN:2 WIRE BLACK	80009	352-0198-00
-185	179-2580-00			1		. WIRING HARNESS,:EXTERNAL SUB CARRIER	80009	179-2580-00
	179-2271-00			1		WIRING HARNESS:HI VOLT	80009	179-2271-00
-186	131-0622-00			20		. CONTACT,ELEC:0.577"L,28-32 AWG WIRE	22526	46241
-187	131-0792-00			20		. CONNECTOR,TERM:18-20 AWG,CU BE GOLD PL	22526	46221
-188	352-0197-00			1		CONN BODY,PL,EL:1 WIRE BLACK	80009	352-0197-00
-189	352-0199-00			1		. CONN BODY,PL,EL:3 WIRE BLACK	80009	352-0199-00
	352-0200-00			1		. HLDR,TERM CONN:4 WIRE BLACK	80009	352-0200-00
-190	352-0201-00			2		. CONN BODY,PL,EL:5 WIRE BLACK	80009	352-0201-00
-191	352-0203-00			1		. HLDR,TERM CONN:7 WIRE BLACK	80009	352-0203-00
-192	352-0201-00			2		CONN BODY,PL,EL:5 WIRE BLACK	80009	352-0201-00
	352-0202-00			2		HLDR,TERM CONN:6 WIRE BLACK	80009	352-0202-00
-193	352-0206-00			1		HLDR,TERM CONN:10 WIRE BLACK	80009	352-0206-00
	352-0201-00			1		CONN BODY,PL,EL:5 WIRE BLACK	80009	352-0201-00
-194	198-2320-01			1		WIRE SET,ELEC:	80009	198-2320-01
	131-0621-00			6		. CONNECTOR,TERM:22-26 AWG,BRS& CU BE GOLD	22526	46231
	131-0621-00			1		. CONNECTOR,TERM:22-26 AWG,BRS& CU BE GOLD	22526	46231
	131-0883-00			4		. CONTACT,ELEC:CRT	98278	101-001-019
	150-0123-01			1		. LAMP,CARTRIDGE:14V,0.023A,YELLOW LENS	55292	71326-06
	162-0006-00			FT		. INSUL SLYG,ELEC:0.106 ID,VINYL,BLK,105 DEG	96904	400-SIZE 10-BLK
	175-0529-00			FT		. WIRE,ELECTRICAL:26 AWG	90484	OBD
	175-0732-00			FT		. WIRE,ELECTRICAL:STRD,26 AWG,150V RMS,VIOLET	80009	175-0732-00
	175-0733-00			FT		. WIRE,ELECTRICAL:STRD,26 AWG,150V RMS,BLACK	80009	175-0733-00
	175-1148-00			FT		. CABLE,SP,ELEC:4,22 AWG STRD,GRAY VINYL JKT	80009	175-1148-00
	352-0200-00			2		. HLDR,TERM CONN:4 WIRE BLACK	80009	352-0200-00

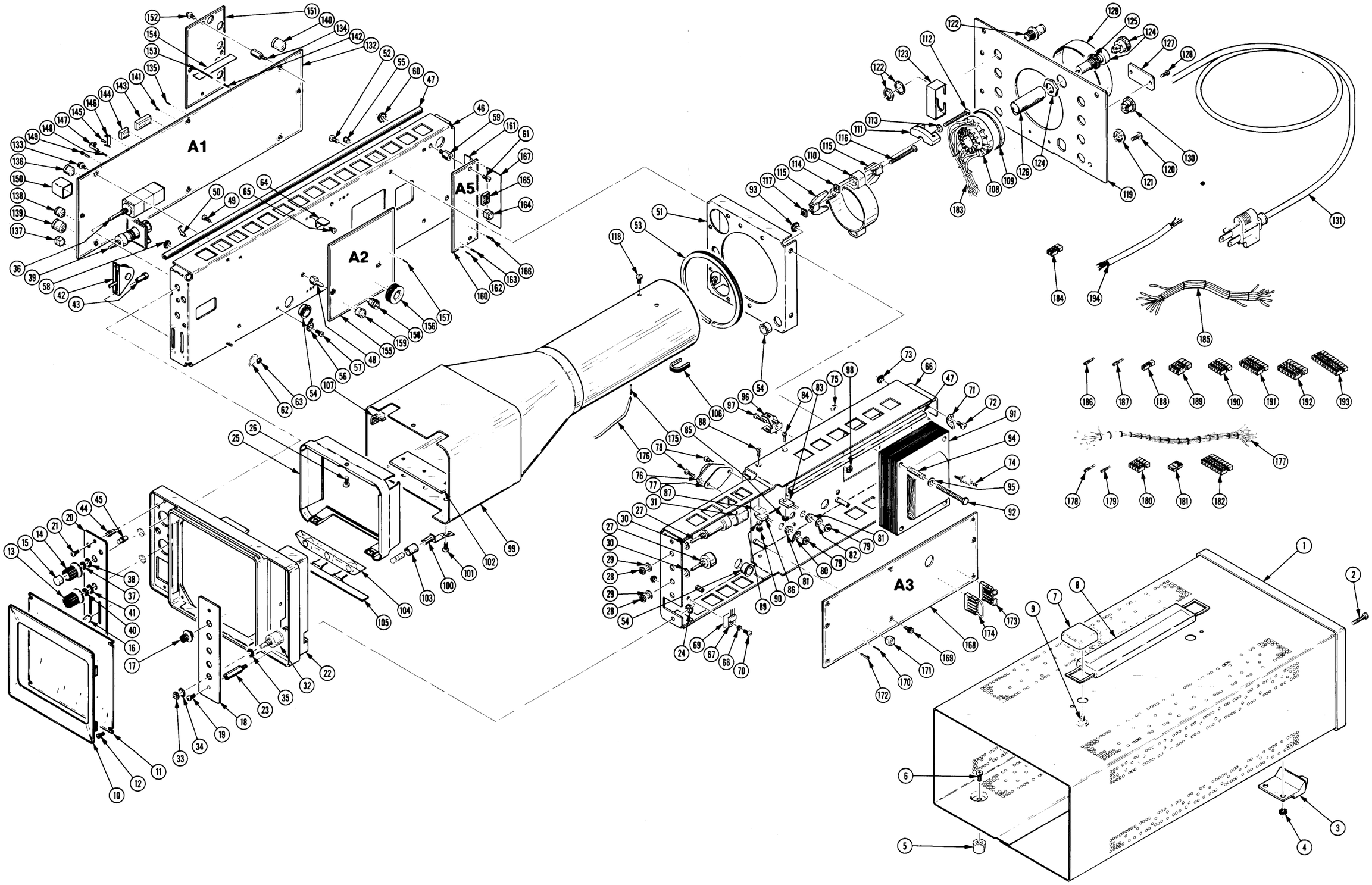

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Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
	011-0102-00			1		TERMN COAX:75 OHM,0.50 W,BNC	80009	011-0102-00
	070-2899-00			1		MANUAL,TECH:INSTRUCTION	80009	070-2899-00